RADIOLOGY

A MONTHLY JOURNAL DEVOTED TO CLINICAL RADIOLOGY AND ALLIED SCIENCES

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THE SASKATCHEWAN 1,000-CURIE COBALT 60 UNIT. *T. A. Watson, M.D., Ch.B., D.M.R., H. E. Johns, Ph.D., F.R.S.C., and C. C. Burkell, M.D., D.M.R.(T).* 165

AN IMPROVED CLINICAL DOSIMETER FOR THE MEASUREMENT OF RADIATION. *S. O. Fedoruk, M.D., H. E. Johns, Ph.D., F.R.S.C., and T. A. Watson, M.D., Ch.B., D.M.R.* 177

ROTATION THERAPY TECHNICS APPLICABLE TO STANDARD DEEP-X-RAY MACHINES. *Morton M. Kligerman, M.D., Elaine G. Rosen, A.B., and Edith H. Quimby, Sc.D.* 183

A METHOD OF TUMOUR LOCALISATION AND FIELD POSITIONING IN RADIOTHERAPY. *H. D. Jamieson, M.Sc.* 195

SIMPLE DETERMINATION OF TOMOGRAPHIC LEVELS. *Milton Elkin, M.D., Alice Ettinger, M.D., and Robert I. Phillips.* 198

NEPHROCALCINOSIS ASSOCIATED WITH SARCOIDOSIS. A PRESENTATION AND DISCUSSION OF SEVEN CASES. *Charles N. Davidson, M.D., John M. Dennis, M.D., Eugene R. McNinch, M.D., James K. V. Willson, M.D., and Webster H. Brown, M.D.* 203

MYELOGRAPHIC DEMONSTRATION OF CYSTS OF THE SPINAL MEMBRANES. *Lewis G. Jacobs, M.D., James K. Smith, M.D., and Philip S. Van Horn, M.D.* 215

CREEPING ERUPTION ASSOCIATED WITH TRANSIENT PULMONARY INFILTRATIONS. *Edmond H. Kalmon, M.D.* 222

REPORT OF A CASE OF OSTEONEPHROPATHY WITH VASCULAR CALCIFICATION IN INFANCY. *Eugene P. Pendergrass, M.D., and Frank P. Brooks, M.D.* 227

PROTECTION OF IRRADIATED RATS BY PARABIOSIS WITH ADRENALECTOMIZED OR SPLENECTOMIZED PARTNERS. *Martin Schneider, M.D., Robert C. Wybourn, M.D., Robert Binhammer, B.A., and John C. Finerty, Ph.D.* 234

CHOLANGIOGRAPHY WITH A VISCOUS, WATER-SOLUBLE CONTRAST MEDIUM. (DIODRAST IN METHYLCELLULOSE). *George Jacobson, M.D., and Kenneth A. Heitmann, M.D.* 241

CHOLECYSTOGRAPHY. A CRITICAL REVIEW. *Robert Shapiro, M.D.* 245

URETHRAL CALCULUS: ITS ROENTGEN EVALUATION. *Paul S. Friedman, M.D., Leon Solis-Cohen, M.D., and Samuel M. Joffe, M.D.* 248

X-RAY STUDIES OF THE ILEOCECAL VALVE IN ILEOCECAL TUBERCULOSIS. *J. Gershon-Cohen, M.D., and Victor Kremens, M.D.* 251

WIDE-ANGLE TRIFOCAL EYEGLASSES FOR RADIOLOGISTS. *D. Alan Sampson, M.D.* 255

X-RAYS IN PHILATELY. *Herbert C. Pollack, M.D., and Charles F. Bridgman, M.D.* 259

EDITORIALS: EUGENE P. PENDERGRASS, M.D. *Robert P. Barden, M.D.* 263

THE THIRTY-NINTH ANNUAL MEETING. 264

ANNOUNCEMENTS AND BOOK REVIEWS. 273

RADIOLOGICAL SOCIETIES: SECRETARIES AND MEETING DATES. 274

ABSTRACTS OF CURRENT LITERATURE 278

RADIOLOGY

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The Saskatchewan 1,000-Curie Cobalt 60 Unit[1]

T. A. WATSON, M.B., Ch.B., D.M.R., H. E. JOHNS, Ph.D., F.R.S.C., and C. C. BURKELL, M.D., D.M.R.(T).

FOR THE PAST YEAR a 1,000-curie cobalt 60 unit (Fig. 1) has been in use in Saskatoon. The unit itself consists of a roughly spherical lead-filled steel casing 22 inches in diameter. Inside the casing is a wheel of heavy metal and lead, having at one point on its perimeter a cobalt source 1 inch in diameter and 1/2 inch thick. A tapered opening leads from the perimeter of the wheel through the lead to the exterior. When the cobalt is opposite this opening, a collimated beam escapes; when the wheel is rotated 180 degrees, the cobalt is shielded by 7 inches of "heavy metal" and the machine can then be considered as "turned off." To turn it on, an electric clock is set to the desired exposure and a switch is turned. The wheel then rotates to the "on" position, and when it reaches this point the clock starts. When the required treatment time has elapsed, the wheel rotates back to the "off" position. A system of interlocks causes the wheel to rotate to the "off" position should the door of the room be opened during a treatment.

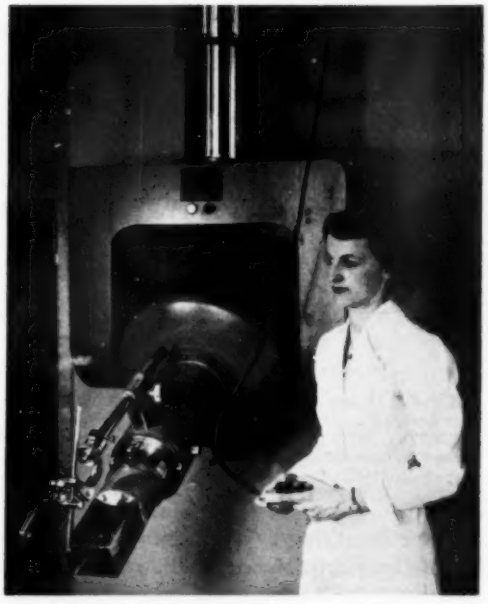

Fig. 1. Saskatoon 1,000-curie cobalt 60 unit. Note push-button motion control and "pin-and-arc" beam director.

The whole unit, which is suspended from overhead rails, has three movements—up and down, forward and backward, and vertical rotation. All of these movements are electrically driven and are controlled from a single small box containing six push-buttons, which is suspended from the ceiling. By means of suitable treatment cones, various fields of 5 × 5 to 15 × 15 cm. can be obtained at 80 cm. source-skin distance. The length of each cone is either 20 cm. or 15 cm., so that ease in porting is assured. Larger fields can be obtained by increasing the source-skin distance. The final limiting diaphragm is located 15 cm. from the skin, so that the

[1] From the Saskatoon Cancer Clinic, Saskatchewan, Canada. Presented at the Thirty-eighth Annual Meeting of the Radiological Society of North America, Cincinnati, Ohio, Dec. 7–12, 1952.

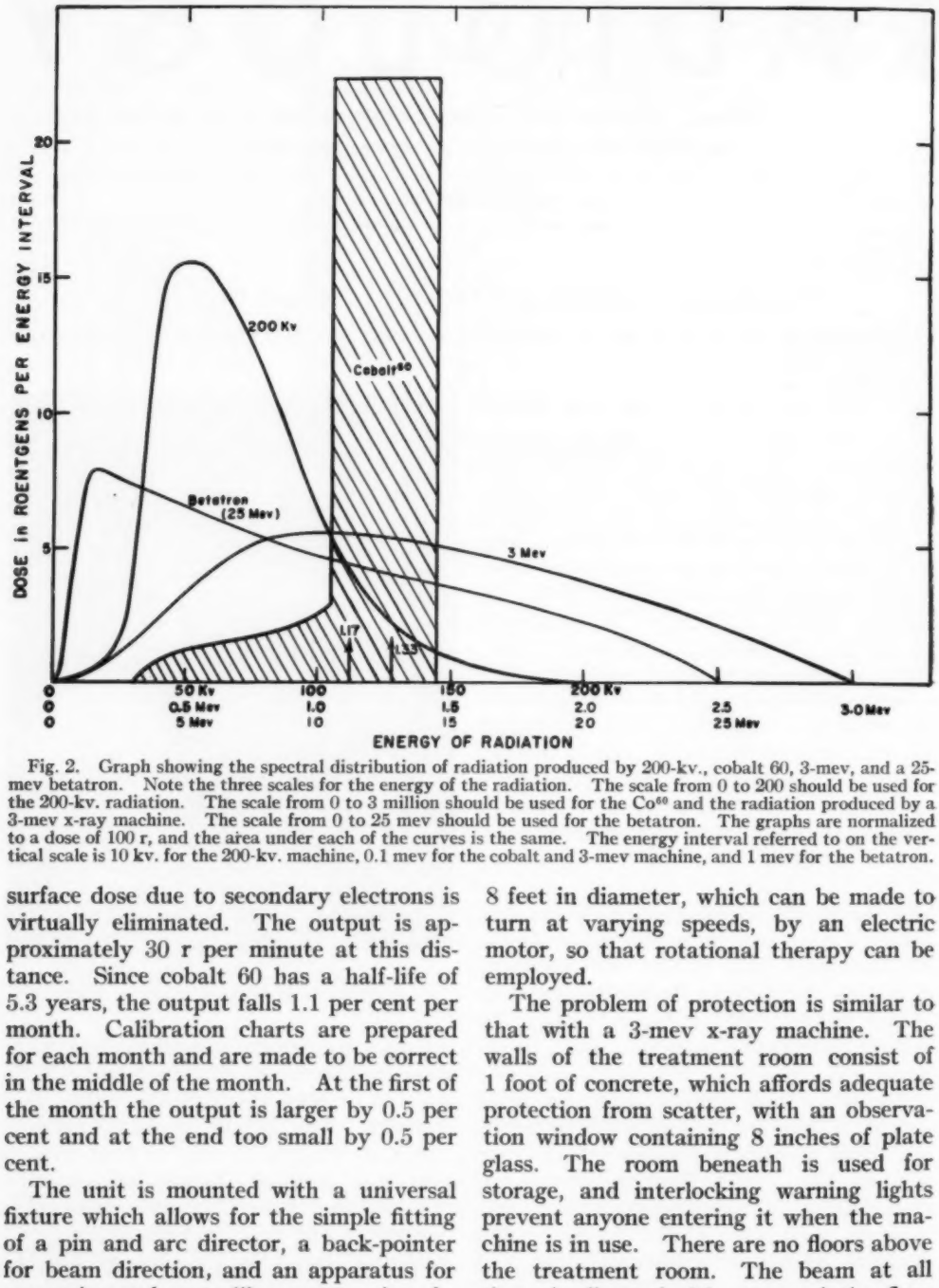

Fig. 2. Graph showing the spectral distribution of radiation produced by 200-kv., cobalt 60, 3-mev, and a 25-mev betatron. Note the three scales for the energy of the radiation. The scale from 0 to 200 should be used for the 200-kv. radiation. The scale from 0 to 3 million should be used for the Co^{60} and the radiation produced by a 3-mev x-ray machine. The scale from 0 to 25 mev should be used for the betatron. The graphs are normalized to a dose of 100 r, and the area under each of the curves is the same. The energy interval referred to on the vertical scale is 10 kv. for the 200-kv. machine, 0.1 mev for the cobalt and 3-mev machine, and 1 mev for the betatron.

surface dose due to secondary electrons is virtually eliminated. The output is approximately 30 r per minute at this distance. Since cobalt 60 has a half-life of 5.3 years, the output falls 1.1 per cent per month. Calibration charts are prepared for each month and are made to be correct in the middle of the month. At the first of the month the output is larger by 0.5 per cent and at the end too small by 0.5 per cent.

The unit is mounted with a universal fixture which allows for the simple fitting of a pin and arc director, a back-pointer for beam direction, and an apparatus for measuring and controlling compression of a patient.

Set into the floor is a circular platform 8 feet in diameter, which can be made to turn at varying speeds, by an electric motor, so that rotational therapy can be employed.

The problem of protection is similar to that with a 3-mev x-ray machine. The walls of the treatment room consist of 1 foot of concrete, which affords adequate protection from scatter, with an observation window containing 8 inches of plate glass. The room beneath is used for storage, and interlocking warning lights prevent anyone entering it when the machine is in use. There are no floors above the treatment room. The beam at all times is directed either toward the floor or the outside wall.

More detailed descriptions of this unit

TABLE I: NUMBER OF ELECTRONS N(E) IN EACH ENERGY INTERVAL WHICH PASS THROUGH 1 SQ. CM. WHEN WATER IS GIVEN A DOSE OF 100 R OF 200-KV., COBALT, 3 MEV, AND BETATRON RADIATION

Energy Interval (kv.)	200 kv. $N(E) \times 10^7$	Cobalt $N(E) \times 10^7$	Energy Int. (mev)	3 mev $N(E) \times 10^7$	Energy Int. (mev)	Betatron $N(E) \times 10^7$
0–10	56.6	42.6	0–0.2	41.0	0–2	124.1
10–20	62.8	61.1	0.2–0.4	50.0	2–4	57.4
20–30	56.0	51.9	0.4–0.6	38.8	4–6	31.9
30–40	50.0	38.5	0.6–0.8	27.8	6–8	19.2
40–50	38.4	19.7	0.8–1.0	19.7	8–10	11.9
50–60	25.3	2.9	1.0–1.2	13.6	10–12	7.4
60–70	16.0		1.2–1.4	9.0	12–14	4.6
70–80	9.0		1.4–1.6	5.8	14–16	2.7
80–90	5.0		1.6–1.8	3.5	16–18	1.4
90–100	1.2		1.8–2.0	1.9	18–20	0.6
100–110	0.4		2.0–2.2	0.9		
110–120	0.1		2.2–2.4	0.3		
Total range (cm.) of all electrons produced per c.c.	321×10^8	217×10^7		212×10^7		261×10^7

and its installation may be found elsewhere (1–4). The unit has proved to be trouble-free and dependable in operation.

Since clinical experience in the use of this unit is very recent, a comparison of the radiation obtained with that produced by conventional and very high-energy machines, from some purely physical aspects, might be pertinent. For several years we have been using a 25-mev betatron in clinical experiments (14), and this radiation, as well as conventional 200-kv. x-rays, will be compared with cobalt radiation.

SPECTRAL DISTRIBUTIONS

Cobalt radiation consists of two gamma rays of 1.17 and 1.33 mev energy emitted in equal numbers as the Co^{60} decays into Ni^{60}. For many purposes we can consider that the beam is monochromatic with an energy of 1.25 mev. In this respect, cobalt radiation is very different from the radiation generated by x-ray machines operating at 200 kv., 3 mev, or 25 mev, which produce a continuous spectrum of radiation. In Figure 2 are shown the spectral distributions for these radiations. There are three horizontal scales: 0–200 kv. to be used with the 200-kv. curve; 0–3 mev to be used with the cobalt and the 3 mev curve; 0–25 mev to be used for the betatron radiation. On the vertical scale is plotted the dose in roentgens per mev interval, and the curves have been normalized so that the area under each of them is 100 r. For example, we see that for the betatron and a dose of 100 r a 4.0-r dose is delivered by x-ray photons with energy between 18.5 mev and 19.5 mev. In the same way, for 3-mev radiation we see that 5.0 r of dose are delivered by photons between 1.35 and 1.45 mev

The 200-kv. distribution shown in Figure 2 was obtained experimentally by Greening (5) and corresponds to a half-value layer of 1.0 mm. of copper. The 3-mev distribution was calculated theoretically by an expression due to Heitler (6). This theoretical distribution was then corrected for filtration by 10 mm. of lead and 5 mm. of copper to yield the values of Figure 2. This filtration is that commonly employed by Trump at these energies (7). The betatron distribution was obtained by a theoretical method described elsewhere (8). For purpose of illustration, the range of cobalt radiation has been increased by equal amounts below 1.17 mev and above 1.33 mev to include the same area as the other curves. If this were not done, the lines at 1.17 and 1.33 mev would have to be infinitely high. The low-energy "tail" of the cobalt is due to scattered radiation within the source itself (3). It is at once seen from Figure 2 that the average energy of radiation produced with a peak energy of 3 mev is quite similar to that from cobalt, while betatron radiation is more penetrating and that of 200 kv. is much less.

TABLE II: PERCENTAGE OF ION PAIRS PRODUCED PER CUBIC CENTIMETER OF WATER WITH ION DENSITIES IN THE INTERVALS INDICATED

(Calculations are for a dose of 200-kv., cobalt, 3 mev, and betatron radiation)

Range of Ion Densities (ion pairs per micron)	200 kv. (per cent)	Cobalt (per cent)	Range of Ion Densities (ion pairs per micron)	3 mev (per cent)	Range of Ion Densities (ion pairs per micron)	Betatron (per cent)
Less than 20	4	21	5.78– 6.00	27	5.78–6.00	35
20–30	13	24	6.0 – 7.0	22	6.0 –6.5	27
30–40	10	15	7.0 – 8.0	11	6.5 –7.0	17
40–50	8	13	8.0 –10.0	12	Greater than 7.0	21
50–60	7	14	10–15	13		
60–80	11	5	15–20	5		
80–100	8	7	20–50	7		
Greater than 100	39	1	Greater than 50	3		
Mean ion density	55	8.3		8.3		6.7

ELECTRON DISTRIBUTIONS AND ION DENSITIES

The biological effect of radiation is produced by the setting in motion of high-speed electrons through the photoelectric, Compton or pair process. Detailed calculations by a method outlined elsewhere (9) have been carried out to yield the spectrum of electrons shown in Table I. The method of calculation is rather involved. Each photon of the original distribution can produce electrons of any energy from zero up to the maximum. This gives one an initial distribution of electrons. Each of these electrons in the slowing up process will momentarily have every energy from its maximum down to zero. The values tabulated in Table I are the final distribution of electrons per square centimeter. For example, we see that for a dose of 100 r of cobalt radiation there are 51.9×10^7 electrons passing through a square centimeter, with energies between 0.4 and 0.6 mev. It can be shown that the totals given at the bottom of the table are equivalent to the total range of all the electrons produced in a cubic centimeter. It is seen that this total range is about the same for cobalt, 3 mev, and betatron radiation and about seven times that of 200-kv. radiation. It should be noted that 200-kv. radiation produces a spectrum of electrons ranging from zero to 120 kv., with the majority of the electrons having an energy in the zero to 40-kv. range. For cobalt there is a slight preponderance of electrons with energies in the range from 0.2 to 0.4 mev. The betatron and 3-mev radiations both produce a preponderance of electrons with energies well below the peak possible energy. From this discussion, it is ridiculous to expect any special effects from cobalt radiation resulting from the monoenergetic nature of the radiation, since the spectrum of the electrons from cobalt is not unlike that for the other radiations.

It is well known that the ion density of an electron track is of some significance in determining the biological effect of the radiation. Since a spectrum of electron energies is produced, there must result a spectrum of ion densities. These are shown in Table II. The data were obtained by a method similar to that given in an earlier publication (9). In Table II are given the percentages of the total ionization produced by tracks with a given range of ion densities. We see, for example, that 21 per cent of the ionization from cobalt radiation is produced with tracks with ion densities in the range from 5.78 to 6.00 ion pairs per micron. An electron with energy of 1 to 3 mev produces a track in water with an ion density of 5.78 ion pairs per micron. This is the minimum ion density, and electrons with either greater or less energy produce a higher ion density track. Since many of the electrons set in motion by the betatron have energies

greater than 1.3 mev, these electrons produce tracks similar to those produced by lower energy electrons. For this reason, the distributions for cobalt, 3-mev, and betatron radiation are very similar.

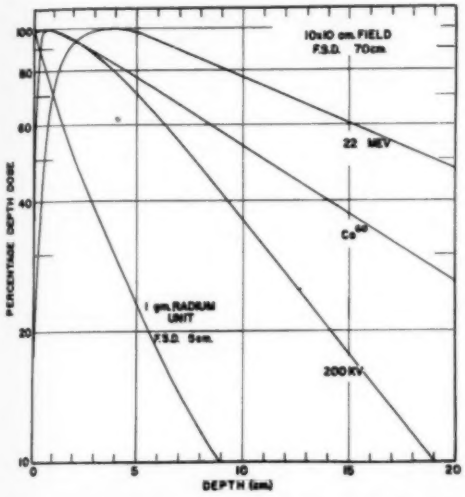

Fig. 3. Percentage depth dose curves for 22 mev, cobalt 60, 200 kv., and 1-gm. radium unit. The 1-gm. radium unit is for a focus-skin distance of 5 cm. and a small field. The other depth dose curves are for a focus-skin distance of 70 cm. and a 10 × 10-cm. field.

The mean ion density of the track is found by dividing the total number of ion pairs produced per cubic centimeter by the total track lengths of Table I. The results are given at the bottom of Table II. These are slightly different from those reported earlier (9) because of differences in the initial distribution and in the stopping powers used for the electrons. It is evident that the distributions of ion densities and mean ion densities for cobalt, 3-mev, and betatron radiation are very similar, and all quite different from 200-kv. radiation. Perhaps this may account for the differences in therapeutic dosage levels required for 200-kv. as compared with the higher energy radiation.

DISTRIBUTIONS OF RADIATION IN PHANTOM

The percentage depth doses produced in a water phantom by the three types of radiation are illustrated in Figure 3. In this work the percentage depth dose is expressed in terms of the maximum dose, which for cobalt and the betatron occurs some distance below the surface of the phantom. In Figure 3 is presented, as well, the depth dose from a 1-gm. radium unit working at a focal skin distance of 5 cm. Although the radiations from radium are somewhat more penetrating than those of cobalt, the depth dose is much poorer because of the very short focal skin distance. The cobalt 60 depth dose is about midway between the graphs for 2- and 4-mev radiation published by Trump (7). As we might have expected from Figure 2, the depth dose obtained from cobalt 60 is about equivalent to 3-mev radiation.

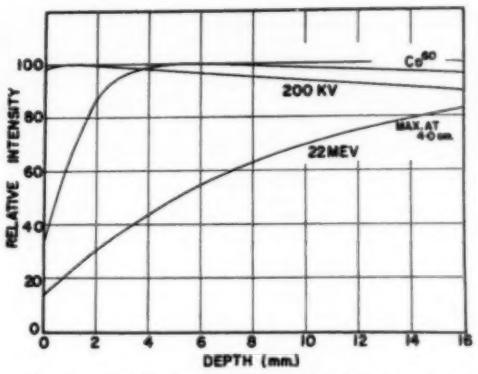

Fig. 4. Graph showing the relative intensity below the surface of the phantom for the first few millimeters of depth. The maximum for the cobalt is at a depth of 6 mm., for the 22-mev. betatron radiation at a depth of about 4 cm., and for the 200-kv. rays on the surface of the phantom.

The three types of radiation show marked differences for the first few centimeters below the phantom surface (Fig. 4). The surface dose for betatron radiation is about 15 per cent and rises to its maximum value, 100 per cent, at a depth of 4 to 5 cm. For cobalt the surface dose is between 30 and 40 per cent, but the dose now rises much more rapidly, reaching its maximum value at 5 mm. The distribution for cobalt in Figure 4 can be achieved only if considerable care is taken in the design and construction of the applicators (2). We consider that this low surface dose probably accounts largely for the

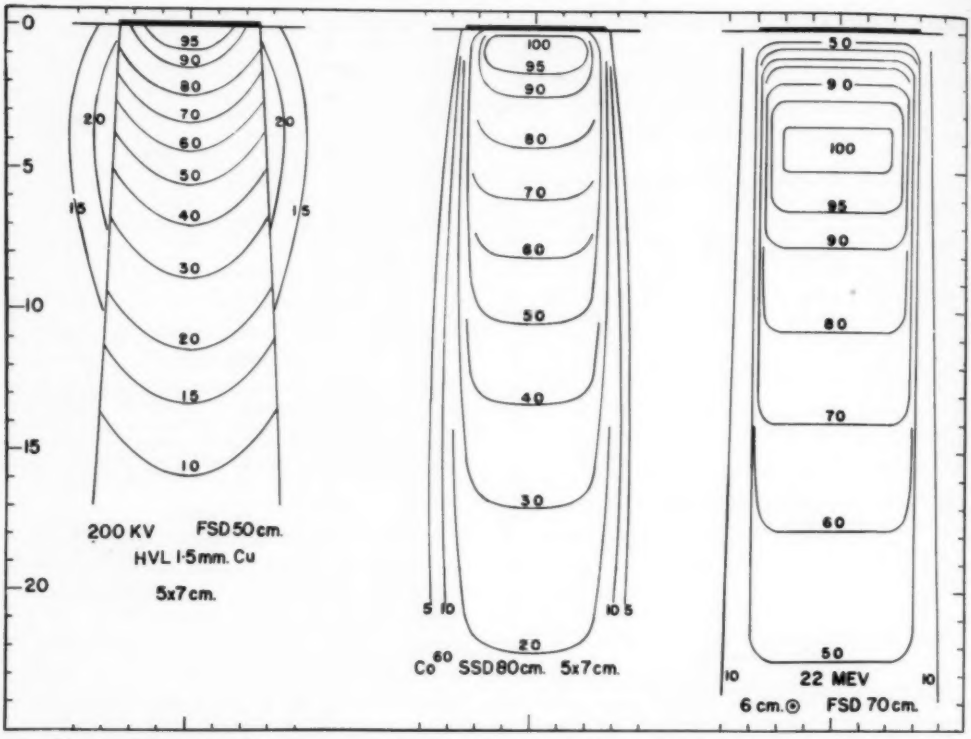

Fig. 5. Comparison of isodose curves for similar fields with 200-kv., cobalt, and betatron radiation.

lesser skin effect of cobalt radiation as compared with similar incident doses of conventional radiation of the 200- to 400-kv. range. This will be discussed later.

Comparison of the complete distributions for typical fields are shown in Figure 5.

It is at once evident that side-scatter at 200 kv. is much more marked than for either cobalt or betatron radiation. For the latter two, difficulties in collimation cause the dose to shade off slowly from the beam proper into the region of scattered radiation, while for 200 kv. there is a sharp discontinuity. One of the difficulties with cobalt radiation is the rather large source, which introduces problems in beam collimation and penumbra effects. In the Saskatoon unit the limiting diaphragms are 15 cm. from the patient's skin and the penumbra region is about 6 mm. wide. The penumbra effects do not introduce any real clinical problems even for the smallest field.

ENERGY ABSORPTION AND INTEGRAL DOSE

One of the reasons high-energy radiation is preferred, from a clinical point of view, over very soft radiation is the abnormally high-energy absorption in bone as compared with soft tissue when photoelectric absorption makes an important contribution to the total energy absorption. When electrons are set in motion by the Compton process, all materials absorb nearly the same amount of energy per gram. At higher energies, when pair production takes place, a differential effect again sets in and we find materials of higher atomic number absorbing slightly more energy per gram. Using the spectral distributions of Figure 2 and the data on energy absorption for monoenergetic radiations published elsewhere (10), we arrive at the data presented

TABLE III: ENERGY ABSORPTION PER ROENTGEN IN TISSUES

	Energy Absorption (ergs per gm.)			Energy Absorption (ergs per c.c.)		
	Fat	Muscle	Bone	Fat	Muscle	Bone
200 kv.	70	91	300	64	91	555
Cobalt 60	98	95	84	89	95	155
Betatron (25 mev)	91	92	91	83	92	168
Density of tissues	0.91	1.00	1.85			

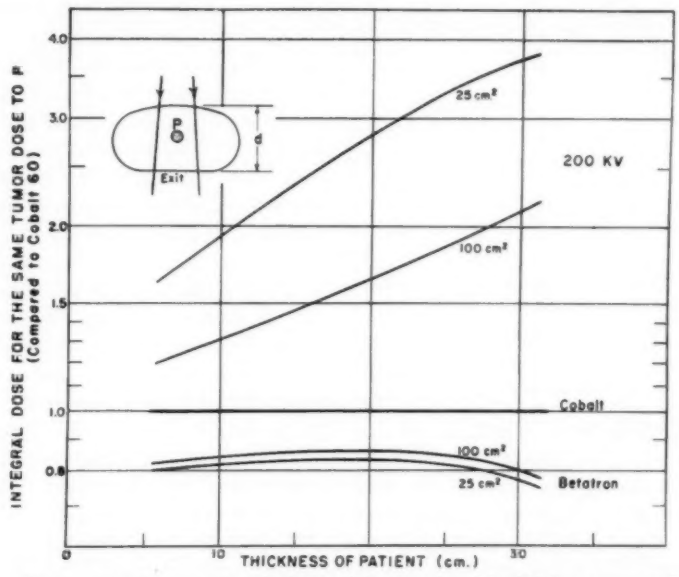

Fig. 6. Graph comparing the integral dose produced by 200-kv. x-rays and the 25-mev betatron, with that resulting from cobalt radiation. Results are shown for two sizes of field as a function of the thickness of the patient. The integral doses have been compared on the basis of the same tumor dose in all three cases, given to the point P at the center of a patient (see insert).

in Table III. In this table the energy absorption per gram of material, as well as the energy absorption per cubic centimeter of material for a dose of 1 r, are presented. The advantage of using either cobalt radiation or betatron radiation in regions where bone or cartilage is involved is obvious.

It is instructive to compare the integral dose delivered by 200-kv., betatron, and cobalt radiation for the same tumor dose. Consider the insert of Figure 6 as showing a patient of thickness d and with a tumor at the central point, P. It is possible to calculate the integral dose from a single field for different thicknesses of patient and then to obtain the ratio of this integral dose to the tumor dose at P. For 200-kv. radiation, the scattered dose was determined by the method of Clarkson (11), using our depth dose data (12). The integral dose was then determined by graphical integration. The 200-kv. calculations were carried out for a h.v.l. of 1.5 mm. Cu at a focal skin distance of 50 cm. for circular fields of 25 and 100 sq. cm. For the betatron, the integral dose was determined by the method outlined previously (8). For cobalt, it was assumed that the isodose curves of Figure 5 were straight lines to the edge of the beam. This is a fairly good approximation. Calculations for the cobalt were carried out for circular fields of 25 and 100 sq. cm., with a focal skin distance of 80 cm. A comparison of the integral doses for the three sources is presented in Figure 6. It is seen that, for

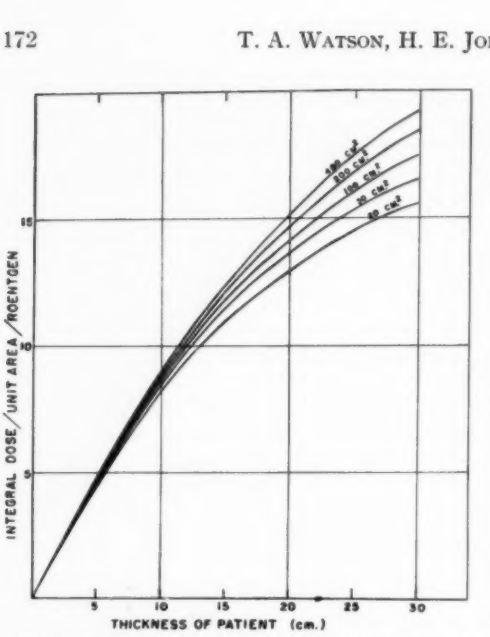

Fig. 7. Graph showing the integral dose per unit area of entrance field per roentgen for different thicknesses of patient and for a number of areas using cobalt 60 radiation at a source-skin distance of 80 cm.

a given tumor dose at a depth of 15 cm. with a patient 30 cm. thick, the integral dose delivered through a 25-sq. cm. field for 200 kv. is about 3.5 times that obtained with cobalt. For a larger field, 100 sq. cm., the integral dose is about 2.0 times as great. In all cases the betatron delivers about 80 per cent of the integral dose given by cobalt. For a patient of small thickness, the advantages of cobalt over 200 kv. are not so great. The comparison between betatron and 200-kv. radiation as shown in Figure 6 bears out the conclusions drawn formerly (13).

The integral dose for cobalt has been plotted for five different sized fields in Figure 7. It is expressed per unit area of field per roentgen. For example, with a patient 20 cm. thick the integral dose per unit area per unit dose on the surface is 14 gm. roentgens for a field of 100 sq. cm. The integral dose for this field for a dose of 1 r is therefore 1,400 gm. roentgens.

CLINICAL USE

As the tissue effects and dosage of x-rays generated at the 1- to 2-mev. level have been fairly well established, it was felt that this experience would hold for cobalt therapy, since the quality of the beam and the depth dose obtained are similar to those produced by an x-ray machine of 3 mev, and, although it is too early to say that definite dosage levels have been established, these assumptions have been largely borne out by experience.

In order to establish dosage levels, we have attempted to keep the factors governing radiation dosage as constant as possible. Hence, we have treated all patients over a three-week period, administering the same dose daily (except Saturdays and Sundays), and have treated all fields each day. The intensity of the radiation, about 30 r per minute, is also constant. With this as a background, our impression is that, while skin tolerance is greatly increased, deep tumor doses are not markedly different from those which we would employ with a conventional 400-kv. apparatus. At the moment, we are employing dosage levels with cobalt from 5 to 10 per cent higher than in similar situations with a 400-kv. machine. For instance, using a beam-directed technic, we are delivering a dose of 5,250 r in three weeks to carcinoma of the larynx, employing fields 5 × 5 cm. In the case of postoperative treatment of carcinoma of the breast we are delivering a dose of 4,000 r, in three weeks, to the center of the axilla, using parallel opposing fields 20 × 10 cm. With 400-kv. radiation, the tumor doses given were 5,000 and 3,750 r respectively. The skin dose has invariably been much less than with 400-kv. radiation, because of the enhanced depth dose, resulting in only a minimal erythema at the end of treatment. In fact, it is impossible to judge the dose given by comparing the skin changes with cobalt and conventional irradiation. It is possible to administer a skin dose of 5,000 r in three weeks to an area of 15 × 10 cm. without producing a pronounced erythema.

The phenomenon of increased skin tolerance is probably due to the fact that the maximum dose does not fall on the surface of the skin, but occurs at 4 to 5 mm. below the surface (see Fig. 4). According to

Klumpar (15), the most critical depth for radiation to affect the skin is 3 mm. below the surface. This is of practical importance whenever large fields are used with cobalt irradiation for, if bolus bagging or even a closed-end applicator is used, the maximum dose is then brought to or nearer the skin surface and thus the skin-sparing effect of this radiation is wasted. For that reason, only open-end cones are used and bolus bagging is dispensed with, even though homogeneity throughout the irradiated volume may sometimes be impaired.

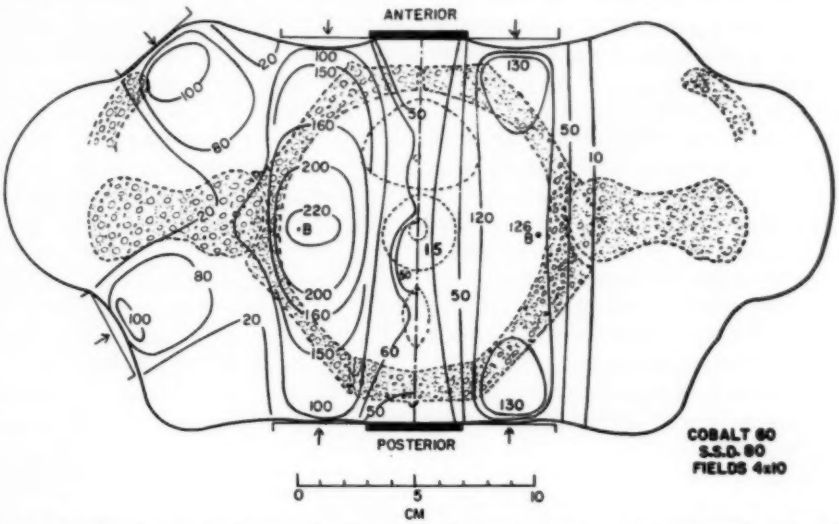

Fig. 8. The right hand side shows the distribution of radiation produced by two opposing "split" fields (each field 4 × 10 cm.) of cobalt 60 radiation at a source-skin distance of 80 cm. The left hand side shows the same distribution with four extra oblique fields added. These distributions are, of course, symmetrical about the line, so that only one-half of each has been given.

The penetrating rays of cobalt radiation make it possible to achieve homogeneity of the central part of the beam through a much thicker block of tissue when parallel opposing fields are used. For example, when 15 × 10-cm. fields are used, the following doses are attained at different separations of the fields:

Separation (cm.)	Skin Dose (Entrance Plus Exit) (per cent)	Central Dose (per cent)
6	173	178
10	156	156
15	140	134

This, for instance, makes it possible to treat the head and neck with parallel opposing fields so as to obtain a central dose equal, or nearly equal, to the skin dose. Similarly, we now treat the parametria, following intracavitary radium for carcinoma of the cervix, by using a parallel opposing pair of "split" 12 × 10-cm. fields, with the "split" being accomplished by a 3-inch plug of lead in the base of the applicator, so that two beams of radiation strike the patient 4 cm. apart. Essentially, this means that point B is irradiated by a parallel opposing pair of fields 10 × 4 cm. in size. With this technic, it is still possible to achieve a tumor dose of 3,000 r in three weeks without skin effects. For the same result with 400-kv. radiation, two oblique fields, as well as the parallel opposing pair, were required for each side. When a similar arrangement of fields is made with the cobalt unit (Fig. 8, left side), the dose received at point B is 220 r per 100 r to each field compared with 50 r at the mid-line. When parallel opposing "split" fields are used, the dose at point B is 126 r compared with 15 r at the mid-line, (Fig. 8, right side). Although in the latter instance the skin

dose is higher than in the former, a much smaller dose is given to the structures in the mid-line when the simpler layout is used. Furthermore, the head of the femur now receives a much smaller dose.

We are using the cobalt unit on a routine rather than an experimental basis and consider that it is indicated particularly for deep-seated tumors, where the higher depth dose can be used to advantage, and in tumors which are adjacent to bone or cartilage, since the differential absorption of these structures, compared with soft tissues, is almost at a minimum at this energy level. Whenever possible, careful beam direction, with plaster casts or the pin and arc, is used. We have also employed wedge fields in certain instances to obtain homogeneity throughout a desired volume. It is not thought that these rays offer any qualitative biological advantages compared with conventional x-rays, but from a physical aspect there is believed to be considerable gain.

Rotational therapy does not appear to offer any advantage over small-field bema-directed technic at this energy, although we intend using it in carcinoma of the esophagus, where it appears important to avoid high dosage to the heart. We consider, in general, that rotational therapy is more suited to lower-voltage machines, where an attempt must be made to improve the low depth dose effect.

SUMMARY

1. Some comparisons of the physical properties of cobalt 60 radiation with that produced at 200 kv., 3 mev, and 25 mev are made. It is shown that cobalt 60 radiation and 3-mev x-rays are similar from the point of view of therapeutic application. When one considers integral dose, surface dose, depth dose, differential absorption of bone and cartilage, the advantages of a high-energy source, such as cobalt 60, are obvious.

2. Some of the practical advantages in the clinical use of a cobalt unit are discussed.

3. The unit is simple, precise, mobile, and trouble-free in operation.

ACKNOWLEDGMENTS: The authors wish to acknowledge the assistance of Mr. D. V. Cormack of the Physics Department, University of Saskatchewan, in some of the physical calculations. Some of the physical investigations were supported by grants from the National Cancer Institute of Canada.

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SUMARIO

El Aparato de Saskatchewan de 1,000 Curies de Cobalto^{60}

El aparato de cobalto^{60} de 1,000 curies, usado durante el año pasado en Saskatoon, Canadá, consta de un recipiente de acero más o menos esférico y recubierto de plomo, dentro del cual se halla una rueda de metal pesado y plomo que lleva en un punto de su perímetro un foco de cobalto de 2.5 cm. de diámetro y 12.5 mm. de espesor. Una abertura cónica conduce desde el perímetro de la rueda, a través del plomo, hasta el exterior. Cuando el cobalto queda enfrente de esta abertura, se escapa un haz colimado de radiación; cuando se rota la rueda 180 grados de esa posición, el cobalto queda resguardado por 17.5 cm. de metal pesado y se considera que el aparato está desconectado. Todos los movimientos del aparato son impulsados por electricidad. Conos apropiados permiten el tratamiento de campos de 5 × 5 a 15 × 15 cm., a una distancia foco-piel de 80 cm.

Preséntase una comparación de la irradiación obtenida por este aparato y con otras formas de irradiación, demostrándose que, desde el punto de vista de la aplicación terapéutica, es similar a rayos X de 3 mev. Al tomar en cuenta la dosis integral, la dosis superficial, la dosis profunda, la absorción diferencial por hueso y cartílago, son evidentes las ventajas de un foco de alta energía, como es el cobalto. Opinan los AA. que es especialmente ventajoso para los tumores profundos, en que puede usarse con provecho la dosis profunda más alta, y en los adyacentes a hueso y cartílago, debido a la diferente absorción por éstos, en los que, comparados con los tejidos blandos, resulta aquélla casi mínima a ese valor de energía.

DISCUSSION

Herbert D. Kerman, M.D. (Louisville, Ky.): Shortly after the advent of the nuclear reactors, the possibilities of producing artificial gamma-ray sources for use as beam therapy devices became readily apparent. Probably similar ideas concerning this development arose simultaneously in several places. In a number of early papers Coliez, Dunworth and Mitchell, Mayneord and Cipriani and others, suggested that the most promising isotope was cobalt 60. Other materials such as Ta^{182} and Ir^{192} were also suggested. A teleiridium unit has been constructed in England and is in use at the present time. Brucer, in a recent survey of possible isotopes for supervoltage therapy, has suggested Cs^{137} and $Eu^{152-154}$ as having suitable characteristics for this purpose.

It was readily apparent that, in order to compete satisfactorily with supervoltage x-ray generators, the activity of the isotope would need to be extremely large—in the order of 1,000 curies—and protection and handling problems would be formidable. However, as has been demonstrated by the Saskatoon group and by others, these difficulties have been overcome, and several units have been designed, constructed, and loaded, and are in clinical operation. Several designs have been utilized, and all appear to be eminently satisfactory, with minor advantages and disadvantages inherent in each. The important and significant fact is that these isotope units can and have been constructed and offer certain distinct physical advantages over x-ray generators in the conventional 200-kv. range.

Dr. Watson and his colleagues have lucidly and definitively demonstrated the physical advantages of this quality of radiation over conventional x-rays. They have also wisely emphasized that the relative monoenergetic beam of cobalt 60 is physically incapable of producing any special effects by reason of its energy spectrum.

As was anticipated, the use of cobalt 60 is practically identical to the use of supervoltage x-ray generators in the same energy range, and the results of such therapy should be similar. The indications for its use are in general the same, that is, to take advantage of the physical superiorities of the beam in respect to increased percentage depth dose, lessened skin effect and volume dose, and to minimize absorption in bone and cartilage. It will certainly not cure radioincurable cancer or make radioinsensitive lesions respond. Its use, as of all radiation therapy, should be in capable hands.

Without consideration of cost, the isotope unit offers advantages in terms of mobility, simplicity, and ease of maintenance. It can be adapted to any technic, and rotational methods can easily be devised, if desired. If high-flux nuclear reactors can be designed and operated for the express purpose of producing high-intensity radiocobalt sources and overcoming the problem of availability of these sources, cobalt units should prove a valuable tool in radiotherapy centers. Their cost, I believe, can be kept within the reach of the average tumor center.

The Saskatchewan group, with characteristic capability and thoroughness, have added another extremely useful and well designed unit to their imposing array of equipment and have maintained their position in the forefront of radiotherapy centers on this continent.

An Improved Clinical Dosimeter for the Measurement of Radiation[1]

S. O. FEDORUK, M.A.,[2] H. E. JOHNS, Ph.D., F.R.S.C.,[3] and T. A. WATSON, M.B., Ch.B., D.M.R.[4]

THE EFFICIENCY of a therapy center which employs various forms of radiation is greatly increased by the use of a versatile, rugged, and simply operated dosimeter. The recent development of high-gain Raytheon electrometer tubes (CK 5886 and CK 5889) has made possible considerable simplification in D.C. amplifiers. The dosimeter to be described consists of only two hearing-aid battery-operated pentodes in a simple circuit. The device is being used for pelvic and esophageal measurements during x-ray and radium treatment. It is also useful in the construction of radium and cobalt molds, in the measurements of depth dose, etc. The dosimeter consists of a D.C. amplifier used in conjunction with interchangeable ionization chambers. These chambers are made in a variety of shapes and dimensions to suit the particular conditions under investigation. The amplifier is capable of measuring instantaneous dosage rates as low as 1 r/hr. with an ionization chamber volume of 0.1 c.c.

PRE-AMPLIFIER DESIGN

A schematic diagram of the pre-amplifier and the end of the typical ionization chamber is given in Figure 1. Details of the inner construction are essentially the same as those described by Johns, Epp, and Fedoruk (1). To increase the versatility of the dosimeter, however, the pre-amplifier of Figure 1 is arranged to contain two grid resistors so that the sensitivity may be quickly altered by a factor of 10. The method by which this is done is illustrated in the figure. The ends of the 10^{11} ohm and 10^{12} ohm resistors and the grid of the 5886 are connected to pins at the bottom of holes A, B, and C. The end of the ionization chamber is fitted with three protruding pins, D, E, and F, which may be inserted into A, B, and C. When this is done, the end of the 10^{11} ohm resistor is

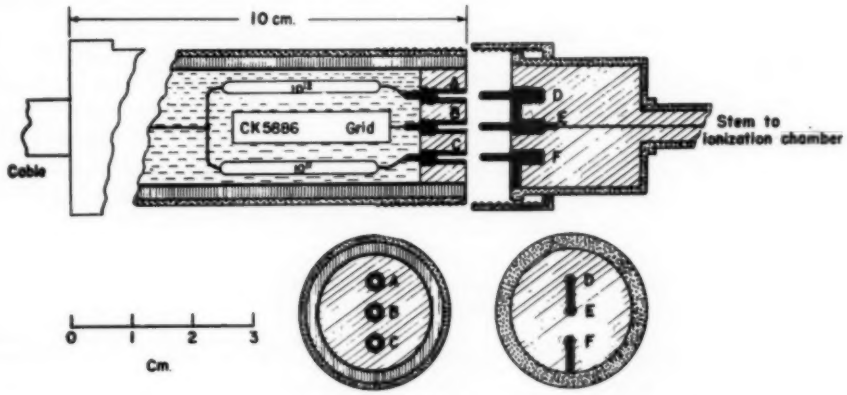

Fig. 1. Schematic diagram of pre-amplifier and showing the arrangement for using either the 10^{11} or the 10^{12} grid resistor.

[1] From the Saskatoon Cancer Clinic and Physics Department, University of Saskatchewan. Presented at the Thirty-eighth Annual Meeting of the Radiological Society of North America, Cincinnati, Ohio, Dec. 7–12, 1952.
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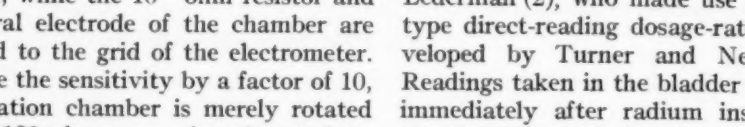
[3] Professor of Physics, University of Saskatchewan, and Physicist to the Saskatchewan Cancer Commission.
[4] Director of Cancer Services, Saskatchewan Cancer Commission.

grounded, while the 10^{12} ohm resistor and the central electrode of the chamber are connected to the grid of the electrometer. To reduce the sensitivity by a factor of 10, the ionization chamber is merely rotated through 180 degrees and re-inserted to connect D to C and F to A. By slight re-arrangement in construction, more than two ranges can be incorporated. This pre-amplifier is connected to the D.C. amplifier with the required length of shielded multi-strand cable.



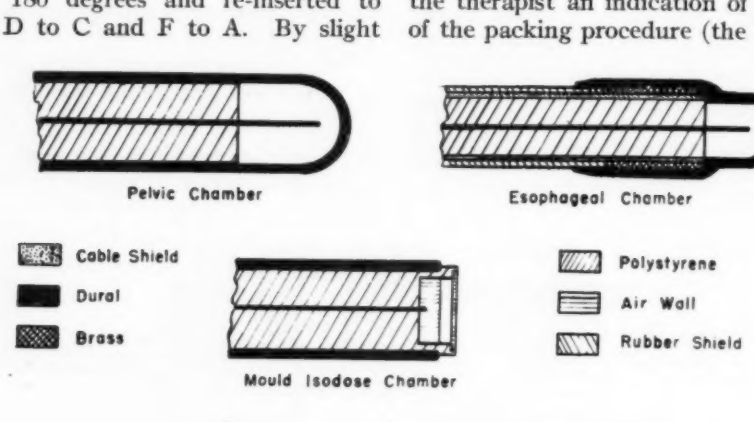


Fig. 2. Schematic diagram of three typical chambers which may be connected to the probe of Fig. 1.

IONIZATION CHAMBER DESIGN

In Figure 2 are shown the details of construction of three typical ionization chambers. Each of these can be connected to the pre-amplifier as indicated in Figure 1. Photographs of the chambers are given in Figure 4.

Pelvic Chamber: The pelvic chamber has a cylindrical air cavity with a diameter of 5 mm. and a length of 6 mm., giving a volume of about 120 cu. mm. Since the chamber was designed to be placed in body cavities, it was made of a single piece of rigid aluminum tubing. It is used in the routine investigation of the dose received in the rectum and bladder during the course of intracavity radium treatment of carcinoma of the cervix uteri. This procedure has been described by Lederman (2), who made use of a probe-type direct-reading dosage-rate meter developed by Turner and Newbery (3). Readings taken in the bladder and rectum immediately after radium insertion give the therapist an indication of the quality of the packing procedure (the Manchester system is used in Saskatoon). If the doses observed are too high, the applicators can be removed and a more suitable plan adopted. Dosage rates from 30 to 50 r/hr. are often observed. These appear to be within the tolerance limits of the mucosa of the bladder and rectum. Since the polystyrene stem and the air volume are encased in the aluminum tubing, the chamber can be immersed in a sterilizing solution before insertion into the body cavity to be measured. Marked on the stem is a centimeter scale, which indicates the exact position of the air volume during measurement.

A device to do essentially the same type of work has also been developed by Fletcher (4) at the M.D. Anderson Hospital, Houston, using a scintillation counter and a small crystal.

Esophageal Chamber: The esophageal chamber (Fig. 2) consists of a cylindrical air cavity, 30 cu. mm., in volume, located at the end of a rubber-covered shielded polystyrene cable, 0.5 cm. in diameter

and 50 cm. in length. The dural cap encloses the cavity and is screwed onto a threaded ring, which is soldered to the cable shield and forms the grounded electrode of the chamber. A short length of Latex drainage tubing has proved to be an excellent means of waterproofing the chamber end of the cable. Reproducible readings of the dosage rate in the esophagus are obtained as long as the patient remains still for a moment or two. Gagging causes spurious meter deflections. The cable presently in use has proved too rigid, and a search for a more flexible cable is under way.

Mold Chamber: Often the hospital physicist is required to check the homogeneity of the dose over the surface of large radium or cobalt 60 molds, and also to determine the dosage rate at the surface. To do this accurately, a chamber of very small depth is required, for the dose changes rapidly with distance from the mold surface. The chamber shown in Figure 2 has a depth of about 0.1 cm. To obtain the required air volume, the area of the chamber can be increased to about 0.4 sq. cm. This does not usually introduce inaccuracies because the dosage rate does not often vary rapidly over the surface of the mold. Dosage rates in roentgens per hour can be read directly from the meter.

Stray Radiation Chamber: By screwing onto the pre-amplifier a chamber with a large volume, 200 to 2,000 c.c., the sensitivity can be increased by a large factor, and the device becomes an excellent stray radiation meter. It may also be used for checking the strengths of radon seeds or radium needles.

Depth Dose and Isodose Chambers: The chambers previously described by some of the authors (1, 5) can be readily used together with this dosimeter to measure the central-axis depth dose and isodose distributions for standard therapy fields.

THE D.C.-AMPLIFIER CIRCUIT

In order to measure ionization currents of the order of 10^{-12} to 10^{-13} amperes, these small currents are passed through a very high resistance of 10^{12} ohms and the signal developed is applied to the grid of an electrometer tube. The input resistance to such a tube must be large compared with 10^{12} ohms or the grid current must be small compared with 10^{-12} amperes. In the circuit previously described (1), a Victoreen 5800 electrometer tetrode which drew a grid current of the order of 10^{-15} amperes was used. To achieve this low grid current, the input signal was applied to the screen grid while the control grid was held at a fixed positive potential to repel positive ions emitted from the filament. Under these circumstances, the voltage gain of the electrometer tube is less than 1.0. To obtain the necessary loop gain and the correct phase relations, at least three more tubes are required. As a result, the circuit becomes complicated. With the new Raytheon pentode electrometer tubes the input signal may be applied to the control grid without grid currents becoming excessive. Under these circumstances, a large voltage gain can be achieved in the electrometer tube itself. This output can be fed into a cathode follower, and the output from this cathode follower fed back out of phase to the input circuit. This negative feed-back is necessary to give stability, linearity, and to reduce the time constant of the input circuit. The cathode follower serves as an ideal tube to feed the output meter.

A complete circuit diagram is shown in Figure 3. This circuit is a modification of one developed by Moody (6) for a portable light-weight protection meter. The circuit of Figure 3 is somewhat heavier than Moody's but has a much higher loop gain, smaller time constant, and better zero adjustment facilities.

To obtain the maximum gain in the electrometer tube, the load resistance R_e must be made large compared with the plate resistance of the electrometer tube r_e. This is difficult to do, because the plate resistance is of the order of 100 to 500 megohms. However, it may be achieved by connecting the negative end of the plate

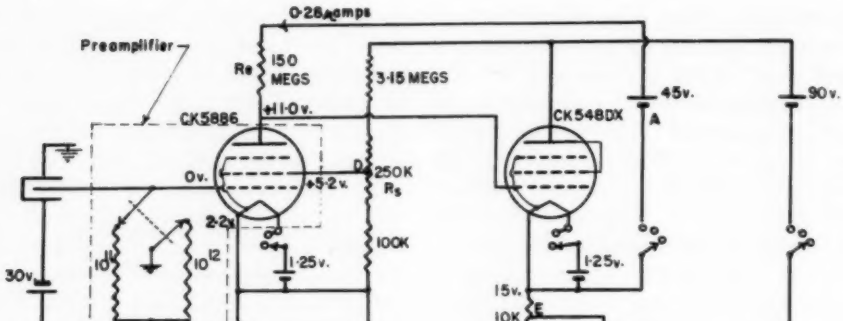


Fig. 3. The electronic circuit of the DC amplifier.

supply battery (point A) to the cathode of the cathode follower instead of to ground potential. This requires a separate battery for the plate of the electrometer but enables one to increase materially the gain of the tube. It can be easily shown that the gain of the first stage is given by

$$\frac{\mu_e}{1 + \frac{r_g}{R_e}(1 - f)} \qquad (1)$$

where f is the gain of the cathode follower.

This gain of the cathode follower, f, is always less than 1.0, but as it approaches 1.0 the gain of the electrometer stage given by (1) approaches μ_e, the amplification factor of the pentode electrometer.

The gain of the cathode follower is given by

$$f = \frac{1}{\left(1 + \frac{1}{\mu}\right) + \frac{1}{g_m}\left(\frac{1}{R_L} + \frac{1}{R_K}\right)} \qquad (2)$$

where μ and g_m are the amplification factor and mutual conductance, respectively, of the cathode follower, R_K is the cathode resistance, and R_L is the load resistance including the meter impedance. With $R_L = 10\ K$, f is about 0.70, and this increases to about 0.85 as R_L is increased to 100 K. The total loop gain of the circuit is the product of (1) and (2) and depends on the operating point chosen for the electrometer. Experiment showed that the maximum loop gain was obtained with a grid bias of 2.0 to 2.5 volts on the electrometer with 9 volts on the plate of the electrometer. This plate voltage was obtained with about 3.0 volts on the screen. With lower voltages on the plate, the gain drops sharply. For these reasons, the signal to be measured was arranged to drive the control grid negative and thus to increase the plate voltage.

The total loop gain, G, of the circuit is given by the product of (1) and (2). It was found to vary from 190 to 260 as the load resistance, R_L, is varied from 10 to 100 K. In any application the load resistance, R_L, would be held fixed and the loop gain would have a fixed value. In any case the actual gain of the circuit with feedback is $G/(G + 1)$, which is very nearly 1.0 and independent of G for wide variations in G.

The operating voltages of the circuit are shown on Figure 3 and are referred to the point 0. Actually, ground potential is 30 volts negative with respect to 0. The screen and grid bias voltages for the

electrometer are obtained from the same bleeder chain. With this arrangement, changes in the bleeder current alter the screen and grid voltages in such a way as to keep the plate voltage of the electrometer tube essentially constant. There are a number of places where the zero adjustment can be inserted in the circuit. If the zero adjustment is made by adjusting the position of the points D or E, which are inside the feed-back loop, the adjustment has a very long time constant and is difficult to make accurately or quickly. For this reason, the zero adjustment is obtained by altering F and G of Figure 3. This gives one a coarse and fine adjustment, both of which are instantaneous in operation. Since a potential ΔE introduced between F and G is similar to an input signal, it alters the potential of B by almost exactly ΔE. B is adjusted until it is at the same potential as 0. Under these circumstances, the current through the microammeter is zero.

For no input signal and the zero adjustments at the middle of their range, the grid of the electrometer is also at the potential of 0. To line up the circuit, it is convenient to break the feed-back connection between C and B and connect the point C to 0. The potential of B can then be adjusted equal to 0 by adjusting the point D and the point E. Adjustments for E and D are placed inside the chassis and are normally not altered.

Because of the high loop gain and the inverse feedback, the instrument is linear in operation and has a small time constant. The linearity was tested by introducing between C and F, known voltages from a potential divider. The output signal was measured with a good microammeter. No deviations from linearity within 0.5 per cent could be observed. The accuracy is limited by the microammeter rather than by the circuit. Because of the small current drains and the simplicity of the circuit zero drift is very small.

A photograph of the completed instrument with several typical probes is shown in Figure 4. The instrument is readily portable and dependable in operation. It is a useful device for many types of work around a radiotherapy department.

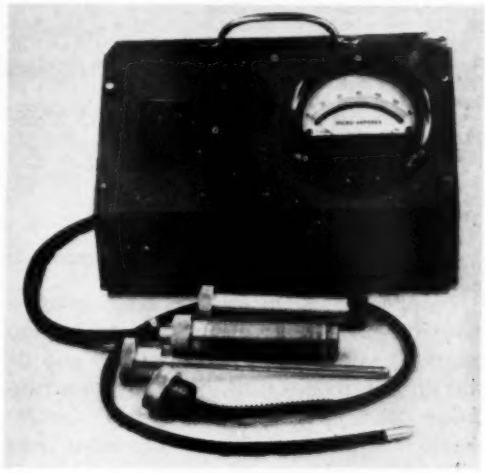


Fig. 4. Photograph of the amplifier showing a pelvic chamber, an esophageal chamber, and a chamber for measuring the output of radium mold.

SUMMARY

By the use of recently developed hearing-aid pentodes a D.C. amplifier consisting of only two tubes can be constructed which will readily measure dosage rates of 1 r/hr. with a chamber volume of 0.1 c.c. The amplifier operating off small batteries has a short time constant and good zero stability. It is being used extensively for pelvic and esophageal measurements during x-ray and radium treatment and in determining the output of radium molds. The device is useful in a number of physical investigations, as of back-scatter and depth dose.

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Canada

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SUMARIO

Dosímetro Clínico Perfeccionado para la Medición de la Radiación

La eficacia de un centro de terapéutica que utiliza varias formas de irradiación aumenta considerablemente con el uso de un dosímetro versátil, sólido y que funciona sencillamente. Los tubos electrométricos introducidos recientemente han permitido una simplificación considerable en los ampliadores de C. D. Usando pentodos de audífonos, se ha construído un ampliador de C. D., compuesto de dos tubos solamente, que medirá sin dificultad dosis de no más de 1 r por hora con un volumen de 0.1 c. c. en la cámara de yonización. Las cámaras de yonización usadas junto con el ampliador permiten hacer mediciones de la dosis en la pelvis y el esófago durante la roentgeno y la curieterapia.

DISCUSSION

Marvin M. D. Williams, Ph.D. (Rochester, Minn.): Those of us who have attempted to make measurements of doses are well aware of the difficulties and problems encountered. One of the difficulties is that, since many instruments respond slowly, it is a time-consuming task to obtain a large series of measurements. Another difficulty is that, because the instruments are not very sensitive, it is necessary to use large ionization chambers, which are particularly undesirable when measurements are being made in rapidly varying radiation fields.

The instrument which has been described by Miss Fedoruk diminishes both of these difficulties. It is a direct-reading instrument with a short time-constant, so that readings can be made rapidly. It has a simple and apparently a stable circuit, which should be more reliable than a complicated circuit having more components to cause trouble. It is sensitive enough to permit small ionization chambers to be used.

Some of the difficulties have been partially obviated in recent years by the use of Geiger counters and scintillation counters. However, the response of a counter and of an ionization chamber to different qualities of radiation may not be the same. In general, the response of an ionization chamber more nearly parallels that of tissue; hence, an ionization chamber is often preferable to the use of a counter.

The instrument which has been described is particularly suited for obtaining data for constructing isodose curves. Many tables are available for calculating tissue dose in the central ray, but information regarding the distribution of the dose toward the edge of the field, which obviously is of great importance, is not so readily available. I should like to point out that the size of the focal spot and the position of the diaphragm that determines the size of the field affect the shape of isodose curves; hence, curves should be determined for the particular type of equipment with which they are to be used. Methods which have been suggested in recent years for calculating the shape of isodose curves probably are satisfactory for regions near the central ray and remote from the edge of the field, but may be unsatisfactory for regions near the periphery of the field.

Joseph C. Bell (Louisville, Ky.): I would like to ask a technical question. Do I understand that in the esophageal chamber that was shown, the polystyrene insulation is the cable insulation? That is, the coaxial cable insulation ran right up to the air volume; or was that a separate source of polystyrene?

Miss Fedoruk (closing): The entire insulation in the esophageal chamber was the cable insulation. For measurements in the esophagus, cable flexibility is desirable and the most flexible insulation available to us was the insulation in the coaxial cable itself.

Rotation Therapy Technics Applicable to Standard Deep-X-Ray Machines[1]

MORTON M. KLIGERMAN, M.D., ELAINE G. ROSEN, A.B., and EDITH H. QUIMBY, Sc.D.

ROTATIONAL X-RAY therapy permits the delivery of a large tissue dose of radiation to a deep-seated tumor, with relatively small doses to adjacent structures and to the skin. This method of treatment may be considered an extreme utilization of the technic of cross-firing, since by rotation of the patient relative to the x-ray beam there are an infinite number of portals of entry.

Since Pohl (5) first suggested rotational therapy in 1906, many radiologists have recognized its advantages. In recent years de Rochemont (6), J. Nielsen (4), Hawley (3), Hare and Trump (2), and Greene (1) have applied the basic method, usually with a particular refinement in equipment or technic. This report sets forth some experiences in the use of a standard deep-therapy machine in conjunction with a unit which rotates the patient in his vertical axis.

Rotational therapy with x-rays of any quality has been shown to have advantages over the use of multiple fixed ports in the treatment of deep-seated lesions. The ratio of tumor dose to skin dose becomes increasingly favorable as the half-value layer increases. Futhermore, radiations of higher energies provide a more homogeneous dosage distribution in any plane perpendicular to the central ray. This can be seen by examination of isodose curves; at higher energies, the curves are flatter. It is, however, practicable to employ x-rays generated at 200–250 kv. The half-value layer of the beam utilized in the work to be reported is 1.5 mm. of copper.

Selection of Target-to-Axis-of-Rotation Distance: For any quality of radiation, the target-axis distance will have to be short enough to give a reasonable dosage rate, but as long as possible for better depth dose distribution. Most of the European work appears to have been done with x-rays generated at 180–200 kv., half-value layer 1.0 mm. of copper, and target-axis distance 50 cm. Although improvement is slight with increased distance, a target-axis distance of 85 cm., which is practicable with the 250-kv. equipment, does afford better depth dose distribution. Since the cross section of the human body is not circular, the target-skin distance varies constantly, but with a target-axis distance of 85 cm. the target-skin distance is seldom less than 65 cm.

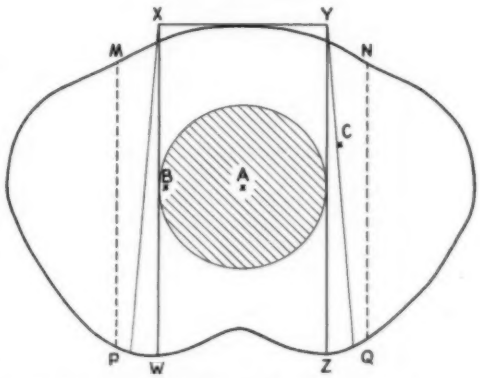


Fig. 1. Schematic drawing showing relation of tumor to "effective" and "semi-effective" beams.

Applicability of Conventional Isodose Charts to Determination of Dose in Rotation Therapy with Radiation of Half-Value Layer 1.5 mm. Copper: Figure 1 shows a centrally located tumor 10 cm. in diameter, lying in the isodose chart for a 10 × 15 cm. field at 70 cm. target-skin distance, half-value layer 1.5 mm. copper. As the

[1] From the Department of Radiology of the College of Physicians and Surgeons, Columbia University, and the Radiological Service of the Presbyterian Hospital, New York.

Presented in part at the Eastern Conference of Clinical Radiologists, New York City, March 29, 1952, and in some detail in an exhibit at the Thirty-eighth Annual Meeting of the Radiological Society of North America, Cincinnati, Ohio, Dec. 7–12, 1952. Accepted for publication in April 1953.

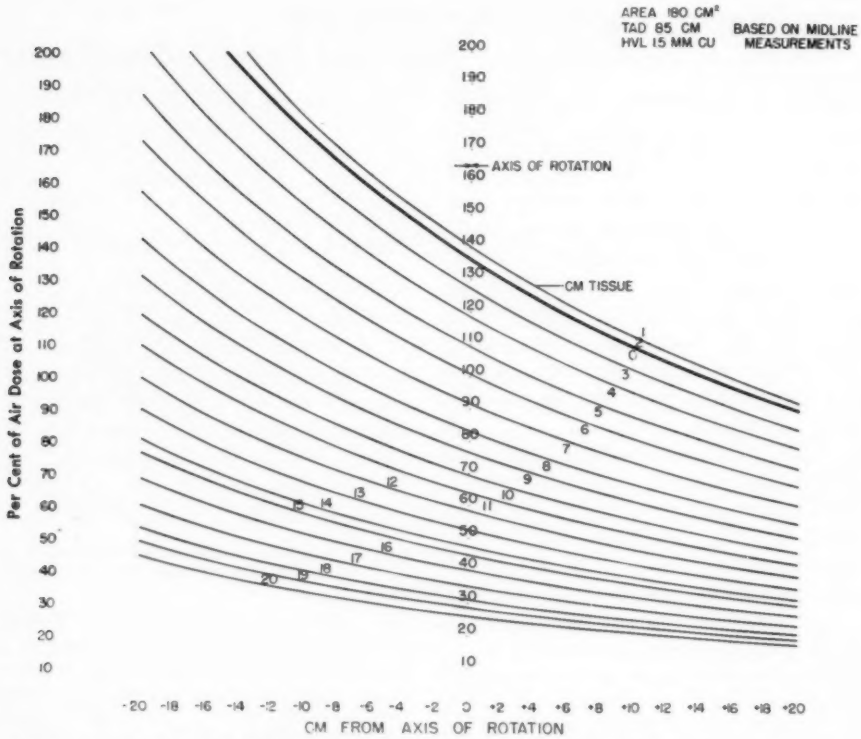

AREA 180 CM²
TAD 85 CM
HVL 1.5 MM CU
BASED ON MIDLINE MEASUREMENTS
AXIS OF ROTATION
CM TISSUE
Per Cent of Air Dose at Axis of Rotation
CM FROM AXIS OF ROTATION

Fig. 2. Curves for calculation of tissue doses in rotation therapy. All values are related to 100 r in air at position of axis of rotation.

body turns on an axis at A, the tumor will always be completely within a region defined by WXYZ, which can be called the "effective beam." All other parts of the body are sometimes in this beam and sometimes outside it. It is not, however, self-evident that doses throughout the tumor are uniform. Part of the mass is always at the center of the beam, and parts are near the edge. As the patient turns, the overlying tissue thicknesses for various points vary markedly. Nor is it self-evident that doses in the tumor are greater than in the skin. Although a skin point is in the beam only part of the time, during less than half of that part it is closer to the tube and has no intervening tissue. It is necessary to make some definite calculations.

As a first approximation to calculation, it is assumed that within the "effective beam" the isodose curves are flat and have the value of the mid-line point. (There is actually a difference of the order of 20 per cent between mid-line and "edge" values. It will be seen later that this introduces no significant error into the calculations.) Therefore, *for the tumor only*, it is possible to replace isodose curves by mid-line data. For off-tumor points, both the spreading part of the beam and the radiation scattered outside it will have to be considered.

Method of Calculation of Tumor Dose: For any point in the tumor, it would be possible to calculate dose as the sum of doses from a series of contiguous or overlapping ports, but a different depth-dose table would be necessary for each one, because of changing target-skin distances.

There are various possibilities for recalculating depth-dose tables to facilitate dosage determinations under these conditions; the method developed at the Mass-

TABLE I: CALCULATION OF ABSORPTION AND SCATTER FACTOR F_s

(h.v.l. = 1.5 mm. Cu. Area = 180 sq. cm. T.S.D. = 70 cm.)

S	D_s	$\frac{(d+s)^2}{d^2}$	$F_s = D_s \times \frac{(d+s)^2}{d^2} \times \frac{1}{100}$
0	136.3	$70^2/70^2 = 1.000$	1.363
1	136.3	$71^2/70^2 = 1.029$	1.402
3	117.0	$73^2/70^2 = 1.088$	1.273
5	95.1	$75^2/70^2 = 1.148$	1.092
10	53.4	$80^2/70^2 = 1.306$	0.697
15	30.3	$85^2/70^2 = 1.474$	0.447
20	15.7	$90^2/70^2 = 1.653$	0.260

achusetts Institute of Technology has been found very useful. In this, the dose received at any point in the tissue is expressed as a percentage of the "air dose at the axis of rotation." This is the dose which would be delivered at the axis of rotation if the patient were not present.

For this purpose, standard depth dose data are transformed by simple calculation into a family of curves for each field size, as shown in Figure 2. Each curve pertains to one definite tissue thickness and gives the variation in dose at this tissue depth for various distances in front of and behind the axis of rotation. The reading on each curve for 0 cm. is the dose at the axis when the axis is at the tissue depth indicated by the curve. Minus distances indicate positions closer to the tube than the axis; plus distances, farther away. As the body turns in the beam, points in the tissue are covered by various tissue thicknesses. Appropriate doses for any point can be determined from the curves, as explained in detail below. In principle, such a family of curves should be developed for each area. With the quality of radiation employed in the present work, however, it was found that about eight sets, covering small, medium, and large fields, were adequate.

Construction of Dosage Charts: For the construction of these families of curves from standard depth dose data, it is necessary to consider that the dose at any point within the tissue is dependent on absorption and scatter of the primary beam, and on the reduction produced by the geometrical spread of the beam (inverse-square law factor). Within practical limits the combined effect of the first two is independent of the distance. The absorption and scatter factor and the inverse-square law factor can therefore be considered separately.

For a particular field and quality of radiation, let

d = target-skin distance
s = depth in tissue
D_s = roentgens at depth s per 100 r in air at position of skin
F_s = absorption and scatter factor for depth s.

$$D_s = 100 \times \frac{d^2}{(d+s)^2} \times F_s$$

The absorption and scatter factors, F_s, are found from standard depth dose data. The formula can be rewritten

$$F_s = D_s \times \frac{(d+s)^2}{d^2} \times \frac{1}{100}$$

Then, from any depth dose table for particular physical factors, values of F_s for various depths are calculated, as shown in Table I.

For any practical target-skin distance, these values of F_s apply to radiation of this quality, with this field. Therefore, the dose at the distance of the axis of rotation can be calculated for every thickness of overlying tissue by multiplying the roentgens in air at this distance by the appropriate value of F_s. For 100 r in air at the position of the axis, all doses would be 100 times the values in the last column of Table I.

To obtain the values for points in front of or behind the axis of rotation, it is now necessary to reintroduce the distance factor. If the axis of rotation is 85 cm. from the target, the distance or "inverse-square" factors for points closer to the target (negative distances) or farther from the target (positive distances) are given in Table II. In practice this tabulation is made for each centimeter.

For radiation of the quality used in Table I, and for a particular thickness of

TABLE II: DISTANCE FACTOR FOR DETERMINATION OF DOSE AT POINTS BEHIND OR IN FRONT OF THE AXIS OF ROTATION

(Target-axis distance equals 85 cm.)

		Distance Factor
Cm. in front of axis of rotation	−20	$85^2/65^2 = 1.710$
	−14	$85^2/71^2 = 1.433$
	−10	$85^2/75^2 = 1.284$
	−4	$85^2/81^2 = 1.101$
Axis of rotation	0	$85^2/85^2 = 1.000$
Cm. behind axis of rotation	+4	$85^2/89^2 = 0.912$
	+10	$85^2/95^2 = 0.800$
	+14	$85^2/99^2 = 0.737$
	+20	$85^2/105^2 = 0.655$

paper the width of the non-divergent beam. On this "effective beam," draw lines 1.0 cm. apart, parallel to each other and perpendicular to a line representing the mid-line of the beam.

4. Place this "beam" with its center at the axis of rotation. All measurements are now to be made with the mid-line of the beam in the center line of each segment.

5. To obtain the contribution from each segment to the tissue at the axis of rotation (Point A, Fig. 3), measure the depth of tissue traversed by the beam between the skin and the point, for each segment at its mid-line. (These measurements are recorded on the dosage calculation sheet, as shown in Table IV.) Find the appropriate dose from the chart, at the zero position, for this tissue thickness.

6. For a point not on the axis (Point B, Fig. 3, and Table IV): (*a*) Measure the amount of tissue between the target and the point. This measurement is taken on a line parallel to the mid-line of the "x-ray beam," from the point in the tissue to the skin. (*b*) Measure the distance that the point is in front of or behind the axis of rotation. This is measured along a perpendicular from the point to the zero line of the "effective beam," which passes through the axis. These measurements are always made when the mid-line of the field is on the center line of the segment. (*c*) From the measurements for depth of tissue and centimeters in front of or behind the axis of rotation, obtain the dosage in per cent of the air dose at the

TABLE III: TISSUE DOSES IN ROENTGENS PER 100 r IN AIR AT 85 CM. TARGET-AXIS DISTANCE

(h.v.l. 1.5 mm. Cu. Area = 180 sq. cm.)

Cm. tissue		0	1	3	5	10	15	20
Cm. in front of axis of rotation	−20	223.1	239.7	217.7	186.7	119.2	76.4	44.5
	−14	195.3	200.9	182.4	156.4	99.9	64.0	37.2
	−10	175.0	180.0	163.4	140.2	89.5	57.4	33.4
	−4	150.0	154.4	140.2	120.2	76.7	49.2	28.6
Axis of rotation	0	136.3	140.2	127.3	109.2	69.7	44.7	26.0
Cm. behind axis of rotation	+4	124.3	127.9	116.1	99.6	63.6	40.8	23.7
	+10	109.0	112.2	101.8	87.4	55.8	35.8	20.8
	+14	100.4	103.3	93.8	80.5	51.4	32.9	19.2
	+20	89.3	91.8	83.4	71.5	45.6	29.3	17.0

tissue, say 5 cm., if the point were on the axis of rotation, the dose would be 109.2 per 100 r in air (Table I). If it were 4 cm. closer to the target than the axis, the dose would be 109.2 × 1.101, or 120 r, the distance factor being obtained from Table II. This value is found in the appropriate place in Table III. All values for Table III were calculated in this manner, and these were used to plot the curves of Figure 2.

Dosage Calculations: The method of using such a set of curves to calculate dosage in a specific case is as follows (see Fig. 3):

1. Draw the patient's contour, indicating the position of the tumor and the position of the axis of rotation.

2. Divide the diagram into twelve 30° segments centered on the axis of rotation. Each segment extends 15° on either side of the center line; the center lines of the segments indicated fall at 0°, 30°, 60°, 90°, etc.

3. Construct a representation of the "effective x-ray beam," using a piece of

TABLE IV: CALCULATION OF DOSAGE FOR INDICATED POINTS

[Per 100 r in Air at Position of Axis (85 cm. from Target)]

	A		B			C		
	Point on Axis		Tumor Point Not on Axis			Point Outside Tumor		
Segments	Cm. in Tissue	Tissue Dose	Cm. in Tissue	Distance from Axis of Rotation	Tissue Dose	Cm. in Tissue	Distance from Axis of Rotation	Tissue Dose
1	12.0	59.7	10.9	0	63.2	...	...	...
2	12.5	55.5	14.0	+3.0	43.9	6.4	−6.2	112.0
3	14.9	42.5	18.0	+5.1	27.5	7.7	−7.7	105.5
4	16.8	36.1	22.9	+6.0	21.5	9.3	−7.0	84.0
5	15.2	41.3	19.7	+5.2	24.6	10.4	−5.6	10/30 × 72.9 = 24.3
6	14.1	46.6	12.0	+3.0	55.6			
7	10.5	63.7	12.4	0	56.8			
8	14.5	44.4	10.8	−3.0	68.0	15.7	+6.2	35.3
9	15.3	41.2	10.3	−5.2	72.2	22.8	+7.8	20.0
10	17.0	35.0	10.7	−6.0	73.3	23.3	+7.0	19.5
11	14.8	42.8	10.7	−5.1	71.6	17.2	+5.5	12/30 × 30.5 = 12.2
12	12.4	56.8	9.7	−3.0	72.9			
TOTAL		565.6			651.1			412.8
Dose at point (average)		$\frac{565.6}{12} = 47$			$\frac{651.1}{12} = 54$			$\frac{412.8}{12} = 34$

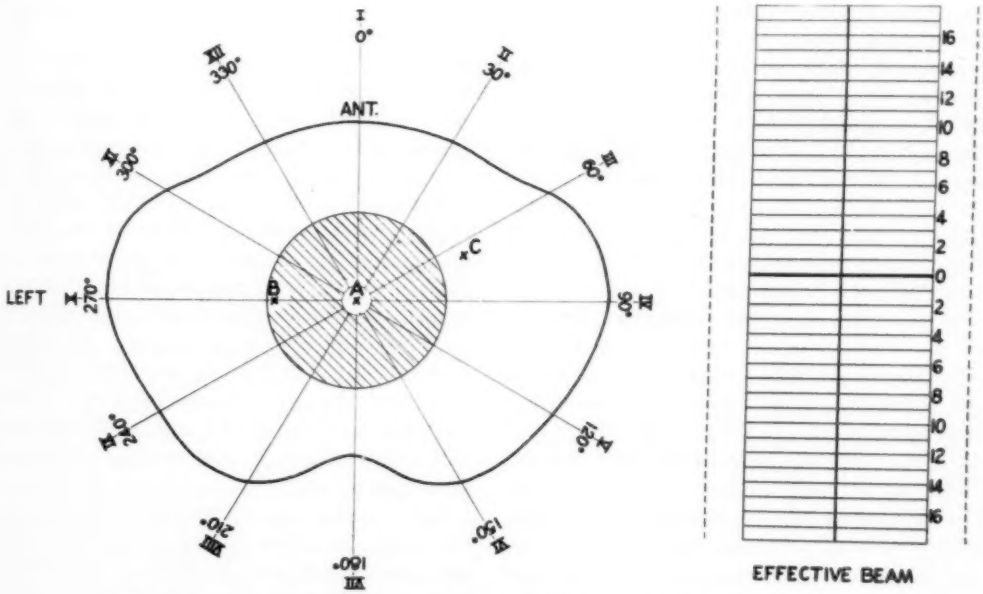


Fig. 3. Diagram to illustrate procedure in dosage calculation. See text for details.

axis of rotation directly from the depth dosage graph.

7. For each point, add all the doses from the segments and divide this sum by the number of segments used (twelve). This average value is the number of roentgens delivered to the point per 100 r in air at 85 cm. (Table IV).

For a point which is not always in the effective beam (Point C, Fig. 3, and

Table IV), the above procedure must be modified. It must first be determined for what fraction of each segment it is in the beam. For example, if for a particular segment it is in the beam for one-half of the 30°, the tabulated dose for that segment will be multiplied by 15/30 to obtain the correct contribution. The measurements for depth in tissue and for centimeters in front of or behind the axis of rotation must be made when the midline of the beam is at the center of the fraction of the segment which is in the beam.

If the point is wholly outside the beam for a particular segment, there is no contribution from the "effective beam." There may, however, be an appreciable amount of radiation either from the spreading part of the beam or from the off-beam scatter; these contributions will be greater the larger the beam. It would be possible to develop a fairly elaborate method for calculating doses in these regions but, since they will always be considerably smaller than any within the "effective beam," an approximate method should be serviceable. Such a simple approximation has been shown experimentally to be satisfactory. It must be remembered that this is a small correction factor for the whole dose, since it applies to only a few segments.

This approximation involves the use of a "semi-effective beam" whose outer limits are 1 cm. beyond the greatest extent of the actual beam employed (indicated by lines MXPW and YNZQ in Fig. 1). During rotation, when the point is in one of these regions, if it is between the tube and axis of rotation, the contribution will be taken as 50 per cent of the axis dose for that interval; if it is farther than the axis, the contribution will be taken as 25 per cent of the axis dose. This very arbitrary correction factor is found to be quite satisfactory in bringing calculated values in line with measured ones.

Experimental Verification of Calculated Doses: Certain calculated doses for small and large fields, and for points within and outside the tumor, have been verified by ionization measurements in specially constructed water phantoms. This work, when completed, will be published as a separate contribution. It is sufficient to say here that, for all tests thus far made, calculated tumor doses agree within 10 per cent of the measured values. About the same agreement is found for points outside the tumor, when the correction approximation outlined above is used.

Positioning Patients for Treatment by Rotation Therapy: By means of x-ray films or a fluoroscopic examination, the lesion is localized. On the patient's skin, two projections of the axis of the tumor, 90 degrees from each other, are marked with silver nitrate. (In practice these are usually anterior and lateral.) The axis of rotation must usually be made to coincide with the axis of the tumor.[2] This is done by shifting the patient on the rotation table. Two trucks which move at right angles to each other are mounted on the rotation table beneath the treatment platform. The patient is placed on the platform in an anteroposterior position, facing the x-ray source, and immobilized by a series of clamps. The rotation table is adjusted so that the position indicator reads zero degrees. The x-ray tube is placed at the desired height and the appropriate truck is shifted until the central axis of the beam coincides with the mark on the anterior skin, as indicated by the light beam localizer. The projection of the center axis of the beam will then intersect the axis of rotation perpendicularly.

The patient is then rotated through 90° and the other truck is moved until the central axis of the field is coincident with the mark on the lateral skin. The axis of rotation now coincides with the axis of the tumor.

The patient is next rotated so that he is again facing the x-ray beam. The shutters of the light beam localizer are opened to the correct field size. A localizing film is

[2] For exception, see Figure 7.

taken in this anteroposterior position with the correct field size. Then, without moving the film or the patient, the shutters are opened wide and another exposure is made on the same film. The same procedure is followed for the lateral view. If the localization is correct, the field size

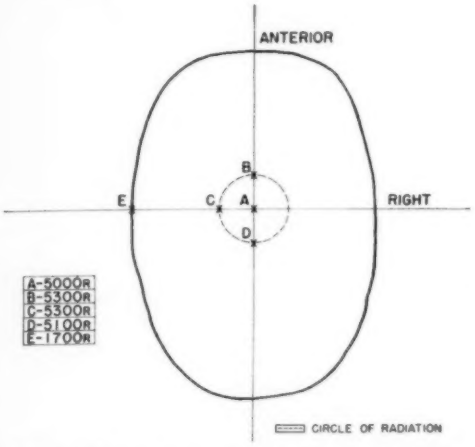


Fig. 4. Centrally located lesion treated with relatively small field. Axis of rotation at center of tumor; simple continuous rotation.

is adjusted to the desired dimensions and treatment is begun.

DISCUSSION OF USEFUL TECHNICS

Several useful technics have been developed which increase the variety of cases which may be treated by rotation with the use of standard deep-therapy x-ray generators (h.v.l., 1.5 mm. Cu).

1. Centrally Located Lesion Treated with a Relatively Small Field: In treatment of the skull, a relatively small field is one which does not exceed 5 cm. in transverse diameter. In treatment of the trunk, a relatively small field is one which does not exceed 10 cm. in transverse diameter.

When relatively small fields are used, continuous rotation will furnish excellent homogeneity throughout a centrally located tumor. In such an instance, the center of the tumor volume is placed at the axis of rotation. The ratio of the tumor dose to maximum skin dose is very favorable.

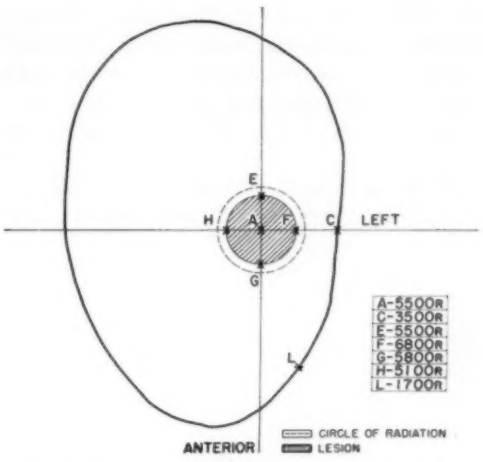


Fig. 5. Small eccentric lesion treated with relatively small field. Axis of rotation at center of tumor and simple continuous rotation give acceptable homogeneity.

In Figure 4 is illustrated the treatment of a pituitary tumor. The head is tipped forward so that the eyes are not irradiated. For a tumor dose of 5,000 r at point "A" it can be seen that the dose throughout the tumor volume does not vary by more than 6 per cent. The treatment is delivered in five weeks. The maximum skin dose is only 34 per cent of the dose at point A. A moist desquamation has never occurred in this type of case. It has been found that the maximum skin dose is always delivered to that point on the skin which is closest to the axis of rotation.

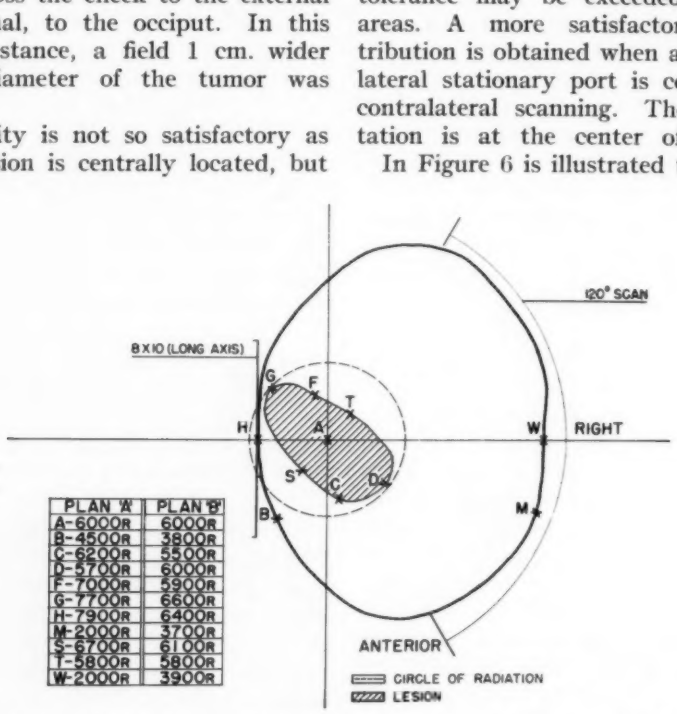
2. Eccentric Lesion Treated with a Relatively Small Field: The width of the treatment field should generally be equal to the horizontal diameter of the tumor-bearing volume. As long as this is of such size that relatively small fields are adequate, a lesion can be somewhat eccentrically located and still be treated by simple continuous rotation. The axis of rotation remains at the center of the tumor.

The case illustrated in Figure 5 was one of destruction of bone around the foramen ovale due to invasion by a cylindroma of salivary gland origin. To avoid irradiating the eyes, the patient's head was tipped back so that the beam traversed

the skin in the following manner: through the lips, across the cheek to the external auditory canal, to the occiput. In this particular instance, a field 1 cm. wider than the diameter of the tumor was employed.

Homogeneity is not so satisfactory as when the lesion is centrally located, but fields are used, with the result that skin tolerance may be exceeded in localized areas. A more satisfactory dose distribution is obtained when a single homolateral stationary port is combined with contralateral scanning. The axis of rotation is at the center of the tumor.

In Figure 6 is illustrated the treatment



PLAN 'A'	PLAN 'B'
A-6000R	6000R
B-4500R	3800R
C-6200R	5500R
D-5700R	6000R
F-7000R	5900R
G-7700R	6600R
H-7900R	6400R
M-2000R	3700R
S-6700R	6100R
T-5800R	5800R
W-2000R	3900R

Fig. 6. Large superficial lesion, requiring relatively large field. Treatment by means of a homolateral fixed port and contralateral scanning. Results of this procedure (Plan B) compared with results of simple continuous rotation (Plan A).

in this case the maximum tumor dose was 133 per cent of the minimum. This high dose is present, however, in only a small area. It has been found that the minimum tumor dose is always at the portion of the tumor which is deepest below the skin surface when the axis of rotation is at the center of the tumor. Though 5,500 r were delivered to the tumor in six weeks, a moist desquamation did not occur at any point.

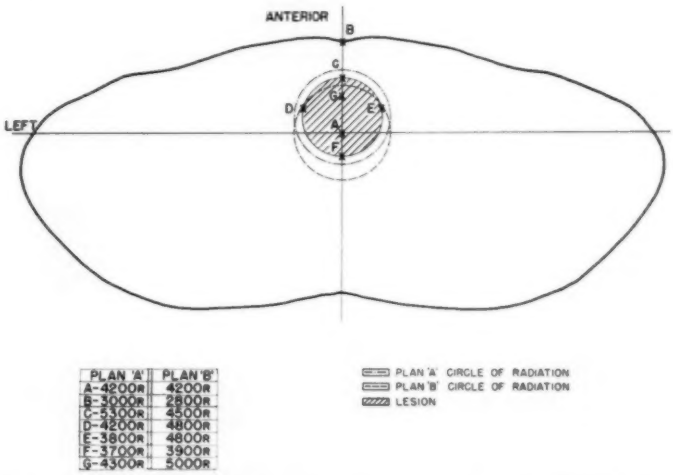
3. Large Superficial Lesions Requiring Relatively Large Fields: Lesions in which the transverse diameter is greater than 5 cm. in the skull, or greater than 10 cm. in the trunk, are better treated by other means than continuous rotation. These tumors require relatively large fields. In continuous rotation, all points on the skin are in the beam more than when small

of a squamous carcinoma of the nasopharynx with direct extension into the right external auditory canal. Plan "A" shows the dosage distribution that would be obtained if complete rotation were used. Plan "B" gives an improved dosage distribution. An 8 × 10-cm. fixed port was placed on the homolateral side. Scanning through 120° was carried out on the opposite side, using a field 8 × 8 cm., 3,000 r were delivered to the center of the tumor from the fixed port and 3,000 r from scanning, to give a total dose of 6,000 r.

Although the maximum skin dose is necessarily high, because the tumor is close to the skin surface, the "hot" area is small, since the dosage drops off rapidly from this region (see points H and B on the diagram).

4. Treatment of Small Superficial Eccentric Lesions: When the axis of rotation is placed at the center of a superficial eccentric lesion of relatively small cross section, the part of the tumor which is nearest the surface receives a considerably higher dose than any other portion. This portion of the lesion was lowered because this "hot" area was no longer in the beam for a complete 360° rotation.

5. Treatment of Relatively Large Eccentric Deep-Seated Lesions: Large eccentric deep-seated lesions may have a more homogeneous dose distribution throughout the



PLAN 'A'	PLAN 'B'
A-4200R	4200R
B-3000R	2800R
C-5300R	4500R
D-4200R	4800R
E-3800R	4800R
F-3700R	3900R
G-4300R	5000R

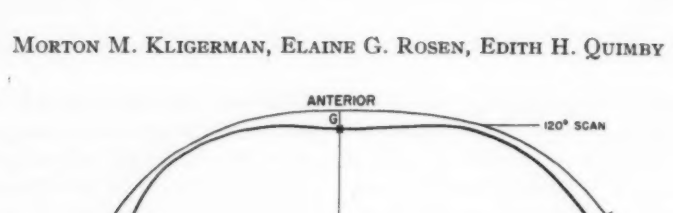
Fig. 7. Small superficial eccentric lesion. Axis of rotation deeper than center of tumor; simple continuous rotation. Results of this procedure (Plan B) compared with results with center of tumor at axis (Plan A).

results from the fact that the more superficial portion of the tumor is in front of the axis of rotation half the time and, during this interval, the beam has relatively little tissue to traverse to the point under consideration, so that a high tissue dose relative to other parts of the tumor occurs. In such cases, homogeneity of radiation throughout the mass may be improved by shifting the axis of rotation. This shift must increase the distance between the axis and the skin; in practice, such a shift is seldom more than 1 or 2 cm.

Treatment of a recurrent tumor in the trachea, just below the tracheotomy opening, is illustrated in Figure 7. The axis of rotation was placed 1.0 cm. deeper than the center of the tumor (Plan "B"). The homogeneity throughout the tumor was thereby improved when compared with simple continuous rotation with the axis of rotation at the center of the lesion (Plan "A"). The dosage in the anterior tumor volume if the techic of *time-differential scanning* is employed. In this procedure, the patient is not rotated through the full 360°. Instead, two areas of the body are scanned, with the tumor centered at the axis of rotation. However, the area whose skin surface is at a greater distance from the tumor is treated for a longer time period.

Illustrated in Figure 8 is the treatment of a carcinoma in the lower third of the esophagus. The patient was treated with his arms raised above his head. Scanning through 120° arcs was carried out anteriorly and posteriorly, the anterior treatment time being twice that of the posterior. This plan ("B") resulted in better homogeneity throughout the tumor volume than would have been obtained by continuous rotation (Plan "A").

6. Bolus Material Used with Great Variation in Body Contour: Great variation in body contour through which a lesion



PLAN 'A' COMPLETE ROTATION	
A	4000R
B	3700R
C	4100R
D	4300R
E	5200R
F	2600R
G	1900R

PLAN 'B' SCANNING	
A	4000R
B	4300R
C	4000R
D	4300R
E	4600R
F	2300R
G	3000R

Fig. 8. Relatively large eccentric deep-seated lesion, treated by technic of "time-differential" scanning. With center of tumor at axis of rotation, two areas are scanned, the area whose skin surface is farther from the tumor being treated for a longer period. Results of this procedure (Plan B) are compared with results for simple continuous rotation (Plan A).

extends prohibits accurate dosage calculation and administration unless bolus material is employed. Tissue-equivalent substances must be used in order to make use of the isodose curves valid, just as with conventional fixed ports. This problem ordinarily does not arise in treatment of the trunk. A cross section through any portion of the trunk measuring 10 to 15 cm. in height rarely shows a variation of more than 4 cm. in diameter. Hence a perpendicular to such a cross section at its widest point will not be more than 2 cm. from the skin surface at the narrowest diameter. This 2 cm. variation in surface contour may be neglected in such overall diameters as the trunk. In regions of the head and neck, however, variations in contour may be significant.

A case of squamous carcinoma of the posterior pharyngeal wall is illustrated in Figure 9. The area involved extended from 2 cm. below the external auditory canal to the level of the hypopharynx. A wax collar was constructed so that diameters through the neck became equal to those through the superior portion of the lesion. Continuous rotation was employed.

CONCLUSIONS

For many types of lesion, simple rotation therapy, with x-rays in the conventional high-voltage range, affords a more satisfactory distribution than ordinary cross-fire. Small, deep-seated tumors are more suitable for this method than large or superficial masses. However, simple rotation is not the only valuable technic. The rotation unit makes possible various methods for the delivery of a desired radiation dose.

The preceding examples have shown the value of scanning, of partial rotation, alone, in combination with fixed fields, and with time-differential scanning of different segments.

Partial protection of certain regions or organs can be achieved by the use of lead strips or cut-outs, just as with stationary fields. This is particularly important in treating the female pelvis. Lead strips fixed on the patient anteriorly and posteriorly decrease the dose on the rectum,

bladder, and skin, while allowing a relative increase in the cervical and parametrial areas.

Each treatment problem is approached as though fixed ports are to be used. Their arrangement and combination are infinite. Groups of such fixed ports merely become segments which can be scanned by rotation. In this manner, any combination of fixed ports, scanned segments and exposure times can be utilized to obtain the greatest homogeneity of dosage in the tumor with a minimum effect on the patient's skin.

SUMMARY

1. By means of rotation therapy, with standard 250-kv. equipment, cancerocidal doses of x-radiation can be delivered to volumes of tissue within the body, without undue damage to the skin.

2. Special charts have been developed for use in determining tissue dosage with such rotation therapy.

3. Central lesions and relatively small eccentric lesions may be treated by simple continuous rotation with the center of the tumor in the axis of rotation.

4. Large eccentric lesions or superficial lesions are well treated by a single homolateral stationary port and a contralateral port which is scanned through a portion of a circle, usually from 120 to 240°.

5. Homogeneity is improved in small superficial eccentric lesions if the axis of rotation is placed deeper than the center of the tumor.

6. Large eccentric deep-seated lesions are often best treated by the technic of time-differential scanning.

7. Bolus material is necessary when the lesion to be treated extends through great variations in body contours. This is especially true in the regions of the head and neck.

8. The rotation unit is simply another tool to improve administration of radiation therapy. It should not be considered as an isolated procedure, but as providing new technics to be combined in the best possible manner with more familiar ones.

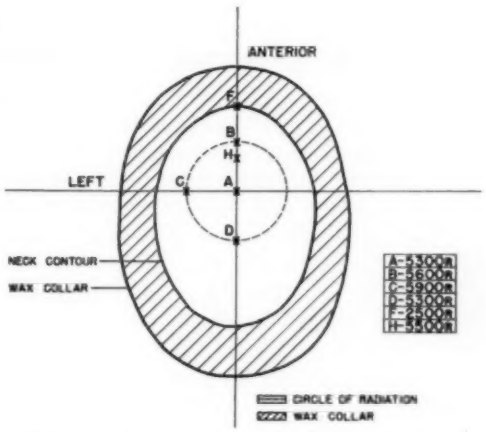


Fig. 9. Bolus material must be used when the tumor extends through great variation in body contour, in order to make use of dosage charts valid.

NOTE: The authors are indebted to Dr. John G. Trump and his associates at the Massachusetts Institute of Technology for valuable aid in adapting their dosage system to radiation in the 200–250 kv. range.

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(Para el sumario en español, véase la página siguiente.)

SUMARIO

Técnica de la Irradiación Rotatoria Aplicable a los Aparatos Corrientes de Rayos X Profundos

Por medio de la irradiación rotatoria con las instalaciones corrientes de 250 kv., pueden llevarse dosis cancericidas de irradiación a volúmenes de tejidos dentro del cuerpo sin peligro exagerado para la piel. Se han elaborado gráficas *ad hoc* para empleo al determinar la dosificación en los tejidos con esta clase de terapéutica. Para muchas clases de lesiones, este procedimiento facilita una distribución más satisfactoria que la técnica ordinaria de fuegos cruzados.

Las lesiones centrales, y las excéntricas relativamente pequeñas, pueden tratarse por la simple rotación continua, con el centro del tumor en el eje de rotación.

Las grandes lesiones excéntricas y las superficiales se atienden bien con una sola puerta estacionaria homolateral y una puerta contralateral, que se escruta a través de una porción de un círculo, por lo general de 120 a 240 grados.

En las pequeñas lesiones excéntricas superficiales, mejora la homogeneidad colocando el eje de rotación a mayor profundidad que el centro del tumor.

Las grandes lesiones profundas excéntricas a menudo se tratan mejor con la técnica cronodiferencial, sin rotar al enfermo los 360° completos. Tómanse dos zonas del cuerpo, centrando el tumor en el eje de rotación y tratando más tiempo la zona cuya superficie cutánea queda más lejos del tumor.

Se necesitan substancias en bolos cuando las lesiones por tratar comprenden muchas variaciones de los contornos del cuerpo, sobre todo en la cabeza o el cuello.

A Method of Tumour Localisation and Field Positioning in Radiotherapy[1]

H. D. JAMIESON, M.Sc.[2]

TUMOUR localisation is often obtained from radiographs and, for some deep-seated sites, can be determined only by this method. The surface localisation on the patient must then be made from the films. For this purpose, fixed reference points are necessary. Radiographs, however, are two-dimensional and magnified, so that all measurements must be made in two dimensions, corrected for magnification, and transferred to the patient.

To overcome the problem, use has been made in this hospital of a special rectangular caliper, together with anteroposterior and lateral radiographs. From each radiograph, the maximum diameter and the distance along it to the tumour centre are measured. By measuring the corresponding diameter on the patient, the radiographic measurement of the distance to the tumour centre along the diameter may be corrected for magnification by simple proportion, and the caliper used to determine this point on the patient.

For such localisation, the posts A and B of the caliper (Fig. 1) are set a distance apart equal to the maximum diameter, and post C is set to indicate the position of the tumour centre in terms of this diameter. The caliper is then applied to the patient, and post C pushed forward until it touches the skin, indicating the superficial aspect of the tumour centre. The reading of the scale attached to C gives the depth from this point on the skin to the line joining A and B.

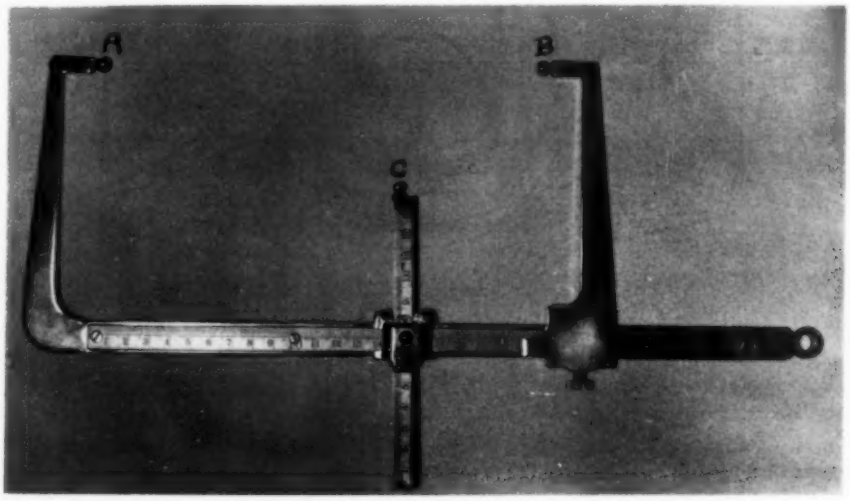

Fig. 1. The caliper.

The caliper is also of value in applying fields to a patient under treatment. The contours of some anatomical regions are irregular and the skin may move easily over underlying structures, so that superficial markings do not always correspond to the correct point deep to the skin. However, if fixed bony structures can be taken as reference points, this problem disappears. The caliper may be used in

[1] Accepted for publication in October 1952.
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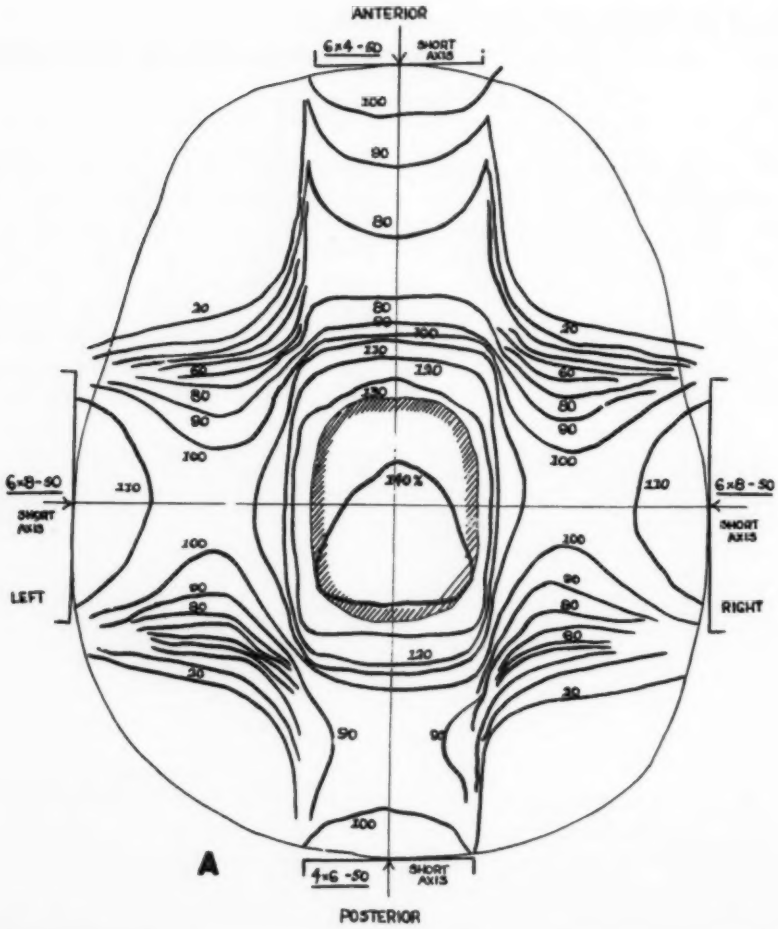

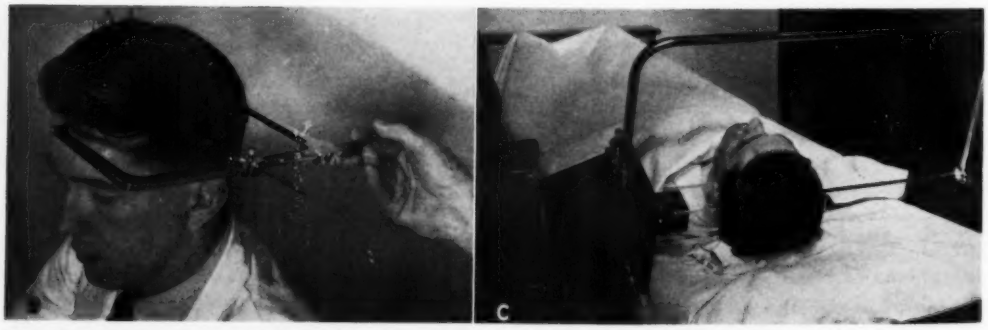

Fig. 2. A. Dose contours for a cerebral tumour. B. Use of the caliper to determine the center of the left lateral field. C. Application of the field, with use of an "exit pointer" for accurate beam direction.

conjunction with such reference points to determine precisely the position of a field, which for a combination of fields in cross-fire may not be directly over the tumour centre.

An example of this application of the

caliper for treatment of a cerebral tumour is shown in Figure 2. The external occipital protuberance and a point 4 cm. above the nasion were taken as the fixed points. Figure 2 shows the treatment plan (A), the use of the caliper to fix the centre of one of the lateral fields on the patient (B), and the application of the x-ray unit to treat the field, with an "exit pointer" to ensure accurate beam direction (C). For any "rectangular" field plan of this nature, the use of the caliper and two maximum diameters at right angles minimises errors which arise through difficulties in determining surface contours or movement of skin over underlying structures.

The dimensions of the caliper are naturally important. The original made here was intended primarily for use with the head and neck, and it was thought another might be made for use on the chest and pelvis. However, one caliper can readily serve all purposes. The maximum dimensions found necessary from our experience are shown in Figure 3. The extra post C should have two independent locks—one to fix the carriage sliding along the main bar of the caliper, the other to fix the graduated scale of C at a given distance from the line joining A and B.

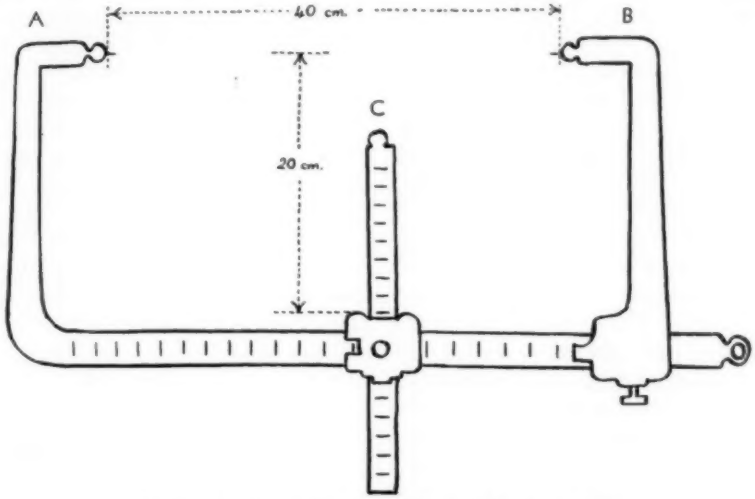

Fig. 3. Maximum dimensions desirable for the caliper.

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SUMARIO

La Localización de los Tumores y Definición de los Campos en la Radioterapia

Cuando va a llevarse a cabo la localización superficial de un tumor profundo por una radiografía, se necesitan puntos fijos de referencia. Como las radiografías son bidimensionales y ampliadas, hay que ejecutar todas las mediciones en dos dimensiones, que descontar el aumento y que trasladarlas al enfermo. Para resolver el problema, se ha elaborado un compás rectangular de calibres, *ad hoc*. En las radiografías anteroposterior y laterales, se miden el diámetro máximo del tumor y la distancia a lo largo de ese diámetro hasta el centro del tumor, midiendo el diámetro correspondiente en el enfermo; la distancia hasta el centro del tumor puede corregirse en cuanto a aumento por proporción simple. Luego se usa el compás para determinar dicho punto en el paciente. El instrumento también resulta útil para definir los campos de tratamiento. En la Figura 3 aparecen las dimensiones máximas del compás que servirá para todos esos fines.

Simple Determination of Tomographic Levels[1]

MILTON ELKIN, M.D., ALICE ETTINGER, M.D., and ROBERT I. PHILLIPS

BODY-SECTION radiography has proved its place in modern x-ray diagnosis. The purpose of this paper is to add a small note to the voluminous literature on the technical aspects of that method of examination. In many instances there appears to be unnecessary indefiniteness as to the levels at which the sections should be made. Sometimes multiple survey cuts are made at 1-cm. intervals to study a lesion where fewer sections would suffice. In a real survey tomogram, as in the search for small cavities or minute metastases in a lung which appears normal by regular technics, the method of "serial sectioning from top to bottom" may have some justification. If, however, one is interested in the details of a small circumscribed area such as calcification in a "coin" lesion or a cavity in a well demarcated zone of infiltration, three or four sections should suffice.

The problem is that of proper localization of the lesion. The method most commonly used is to study anteroposterior (or postero-anterior) and lateral views; although not exact, this technic usually affords localization within a few centimeters, which in general is close enough. Unfortunately, it is not always applicable. The lesion may not be visualized on the lateral view. There is a machine in production with which determination of tomographic levels is made fluoroscopically. We are describing, however, a procedure which is applicable to equipment not having such arrangement.

Our method is not a new one, being almost as old as the knowledge of x-rays. It is merely an adaptation of one of the technics of localizing a radiopaque foreign body, for which many procedures have been devised. One of the basic principles is that of triangulation, first described by Buguet and Gascar in March 1896 (1), less than six months after Roentgen's announcement of the discovery of x-rays. Similar sides of similar angle triangles are compared. Two exposures are made on one film; in the first exposure the tube is centered over the region of the foreign body; the tube is then shifted a known distance and a second exposure is made. This is the single-shift or single-triangle method. The two exposures may, however, be made from either side of center, constituting the double-shift or double-triangle method. Figure 1 illustrates the simple mathematics of the single shift. In this figure:

F represents the foreign body.
a is the point from which the initial exposure is made, with the image of F falling at point d of the film.
b is the point from which the second exposure is made, with the image of F now falling at point c of the film.
A is the distance of the tube shift.
H is the target-film distance.
x is the distance of the foreign body above the film.
B is the distance of the shift of the image, measured directly on the doubly exposed film.

Comparison of similar sides of the similar angle triangles leads to the equation:

$$\frac{B}{A} = \frac{x}{H - x} \quad \text{or} \quad x = \frac{BH}{A + B}$$

Inasmuch as all the values except x are either known or are easily available, x can be determined from the equation. The equation for the double-shift method is the same. Obviously, any convenient distances may be used for A and H.

Seelentag (2) described a double-exposure method of determining tomographic levels. At known points of the tube

[1] From the Departments of Radiology, New England Center Hospital and Tufts College Medical School, Boston, Mass. Accepted for publication in February 1953.

travel he made two separate exposures of a model consisting of nails hammered into a block of wood at predetermined distances. From measurements on the resulting double-exposure film, a graph was constructed for the determination of the level of the unknown objects. Inasmuch as the

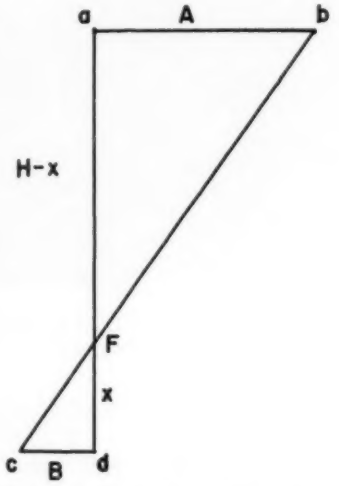

Fig. 1. Similar angle triangles of the single shift.

double exposures in this method are made with the equipment arranged for tomography, the Bucky tray changes its position as the position of the tube is changed for the two exposures. Since the position of the film is not fixed, the simple mathematics of similar triangles cannot be used, and rather than engage in complicated mathematical steps, Seelentag employed the empirical approach. In the method which we use, the localization is performed before the x-ray equipment is arranged for tomography. Thus, the position of the tube can be altered without moving the Bucky tray.

The following case will illustrate our technic. A routine chest film (Fig. 2) of J. H., a 45-year-old man, revealed an irregularly rounded zone of soft-tissue density in the left lower lung field, measuring 1.0 to 1.5 cm. in diameter. The lesion could not be identified on the lateral view. In an attempt better to delineate the out-

Fig. 2. Lesion of left lower lobe seen on routine postero-anterior chest film.

line of the lesion, as well as to search for calcification within it, body-section radiography was suggested. The procedure is as follows. With the patient supine, the area of the lesion is centered to the midline of the table and the tube centered over the area of the lesion. A 14×17-inch loaded cassette is placed in the Bucky tray and centered to the tube, the tray being locked to prevent movement during the subsequent steps. The target-film distance is 48 inches. The tube is then moved 15 inches cephalad and angled 25 degrees toward the feet; the cephalad half of the face of the cassette is protected by a piece of lead or leaded rubber of appropriate size. An exposure is made using regular Bucky chest technic for the distance. The tube is now shifted 30 inches caudally (or 15 inches beyond the initial center point) and angled 25 degrees toward the head; the protective lead covering is moved to the caudal half of the cassette to protect the already exposed portion of the film, and another exposure is made. The film is developed (Fig. 3), and the distance between the two images of similar parts of the lesion (arrows in Fig. 3) is measured; this is B, measuring here 6.0 cm. A is 30 inches, or 76.2 cm.; H is 48 inches, or 121.9 cm. Substituting these values in

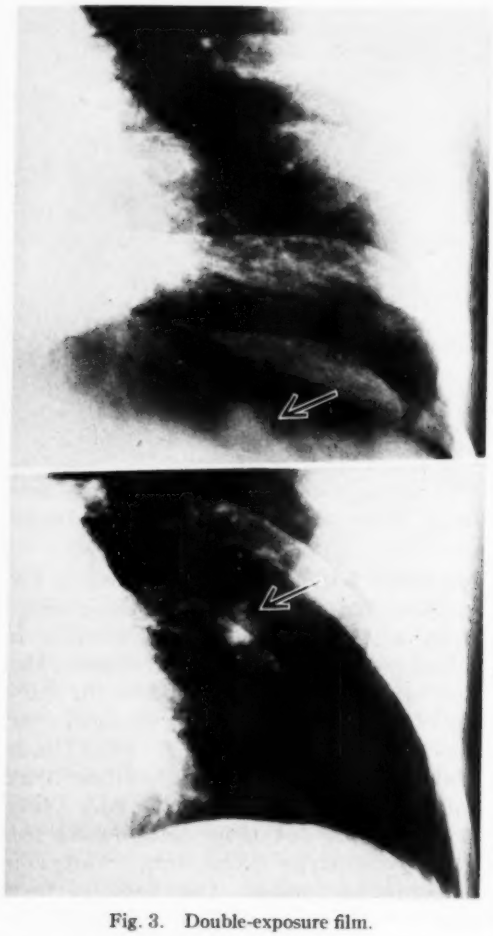

Fig. 3. Double-exposure film.

the formula, the lesion was calculated to be 8.9 cm. above the film in the Bucky tray. A correction must be made for the distance of the Bucky tray to the table top (4.5 cm. on our table), this distance being subtracted from the value of x to yield the desired value, *i.e.*, the distance of the lesion above the table top, 4.4 cm. in this case. The tomogram made at the 4-cm. level (Fig. 4) showed an area of calcium within the lesion, suggesting that this was a tuberculoma. This diagnosis was confirmed at subsequent examination of the surgically removed lesion; the central core had undergone calcification. Cuts made at levels 3 and 5 cm. from the table top demonstrated that the section at 4 cm.

Fig. 4. Body-section film at 4 cm. showing central area of calcification. Cuts at 3 and 5 cm. showed the 4 cm. level to be the best, as predicted.

was the best, as predicted by the triangulation method.

Instead of performing this simple arithmetic for each case, we have constructed a chart (Chart I) of the values of x, as well as the actual lesion-table top distances corresponding to various values of B. In practice, the value of B is obtained from measurement on the wet "double-exposure" film and the proper level obtained from the chart, sections being then done at the determined level as well as at 1 cm. above and below.

Occasionally, in the double-shift method, the lesion will not be seen on one of the exposures, being covered by overlying bone. In that case, the single shift may be used with the proper mathematical adjustments considered in solving for x. If a single shift is made, using our factors—*i.e.*, 48 inches distance, with one exposure centered right over the lesion and the other after a 15-inch shift of the tube—then the measured value of B must be doubled before using the chart (Chart I). Thus, if the distance between the two images measures 4.0 cm., the value of x corresponding to B of 8.0 cm. should be used.

We believe that this method is accurate within 0.5 cm. for sharply outlined objects. Experiments with a phantom have indicated that the degree of angulation of the tube at each point of exposure (25 degrees) is not a critical value, since variations of this angulation from 15 degrees to 35 degrees have produced a variation of only a few millimeters with test objects at various heights from the table top. Nor is failure to orient the test object directly over the center of the table critical, since placing of the object as much as 15 cm. to the right or left of the mid-line has produced no significant error. If the object is placed too far caudad or cephalad in respect to the center of the cassette in the Bucky tray, the error again would be inconsequential, but such misplacement, if of any magnitude, would project both images on the same side of the mid-line of the film; however, since that side of the film is protected by lead during one of the exposures, a double-exposure of the object would not be obtained and the incorrectness of centering would be obvious.

This technic has proved of value in localizing small lesions in the lungs, calcified areas within the skull, and calcified areas in the abdomen. Occasionally a pulmonary lesion is seen only on an oblique film where estimation of "depth of lesion" cannot be made by the anteroposterior-lateral method. In such a case the tomographic cuts are made with the patient immobilized in the optimal degree of obliquity, the level of the cuts being determined by the localization method.

The chief significance of a method of more precise localization of levels of tomography is that of economy—economy of time, film, and irradiation. Instead of making many cuts, the technician is able to complete the examination with three or four cuts after the preliminary double exposure. The method of tomography then approaches the category of being a routine rather than a time-consuming special procedure.

CHART I

B (cm.)	x (cm.)	Distance from Table Top (cm.)*
3.5	5.4	0.9
4.0	6.1	1.6
4.5	6.8	2.3
5.0	7.5	3.0
5.5	8.2	3.7
6.0	8.9	4.3
6.5	9.6	5.1
7.0	10.3	5.8
7.5	10.9	6.4
8.0	11.6	7.1
8.5	12.2	7.7
9.0	12.9	8.4
9.5	13.5	9.0
10.0	14.1	9.6
10.5	14.8	10.3
11.0	15.4	10.9
11.5	16.0	11.5
12.0	16.7	12.2
12.5	17.2	12.7
13.0	17.8	13.3
13.5	18.3	13.8
14.0	18.9	14.4
14.5	19.5	14.9
15.0	20.0	15.5
15.5	20.6	16.1
16.0	21.2	16.7
16.5	21.7	17.2
17.0	22.2	17.7
17.5	22.8	18.3
18.0	23.3	18.8
18.5	23.8	19.3
19.0	24.3	19.8
19.5	24.8	20.3
20.0	25.3	20.8

* NOTE: 4.5 cm. correction for the Bucky tray-table top distance for our table; this may vary for other tables.

SUMMARY

A method is described for localization of the level for tomography of a sharply defined object. Use is made of the principle of triangulation, as for localization of a foreign body.

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Boston 11, Mass.

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(Para el sumario en español, véase la página siguiente.)

SUMARIO

Sencilla Determinación de los Niveles Tomográficos

Descríbese un método para la localización del nivel mejor para la tomografía de un objeto netamente definido, tal como la calcificación en una lesión de las llamadas de "moneda" o caverna en una zona bien demarcada de infiltración. Básase el mismo en el principio de la triangulación, como en la localización de un cuerpo extraño. Bosquéjase el sencillo cálculo aritmético que se requiere, pero para evitar la necesidad de verificar esos cómputos en cada caso, preséntase una gráfica que permite determinar fácilmente el nivel deseado. Según se cree, la exactitud del método no discrepa más de 0.5 cm. en las lesiones netamente delineadas. Ha resultado útil el mismo para localizar pequeñas lesiones pulmonares y zonas calcificadas dentro del cráneo y del abdomen. Su importancia principal radica en la economía: de tiempo, película e irradiación.

Nephrocalcinosis Associated with Sarcoidosis

A Presentation and Discussion of Seven Cases[1]

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OVER FIFTY years have passed since Boeck first described a condition of the skin which he designated as sarcoid. Since that time many observers and investigators have contributed freely to the literature concerning the various manifestations of this disease The findings of greatest interest to us in sarcoid are hypercalcemia and soft-tissue calcifications, particularly nephrocalcinosis and nephrolithiasis. Very little is to be found in the literature referable to these changes, although hypercalcemia is given more attention than soft-tissue calcifications.

During the past several years, at the Johns Hopkins Hospital, the Hospital of the University of Pennsylvania, and the University of Maryland Hospital, we have had the opportunity of studying and reviewing 7 cases of sarcoidosis with hypercalcemia and renal calcifications. Although roentgenograms for only 5 of these cases are now available, the histories of all 7, including postmortem studies in 3, will be presented.

CASE REPORTS

CASE I: N. S., a 44-year-old white male, was admitted to the Hospital of the University of Pennsylvania in September 1950, complaining of weakness, urinary frequency, nocturia, hematuria, and passage of white granular particles in the urine.

Chronology of Symptoms: The onset of symptoms was in September 1949. At that time the patient was hospitalized elsewhere and, on the basis of clinical, roentgenologic, and laboratory studies, an impression of hyperparathyroidism was obtained. The parathyroid glands were explored surgically but no tumor or hyperplasia was found. Thereafter the physical status remained essentially unchanged until hospitalization at the University of Pennsylvania in September 1950.

Significant Physical Findings: Calcium deposits were found in the sclera, conjunctiva, and cornea of each eye. Enlarged lymph nodes were present in the left axilla, and the spleen was enlarged to two fingers below the costal margin.

Roentgen Findings: Roentgen examination showed miliary pulmonary infiltration bilaterally (Fig. 1A), bilateral nephrocalcinosis and a prominence of the gastric rugae (Fig. 1B), and numerous periarticular soft-tissue calcifications about the shoulder and hip joints, but with no bony demineralization (Figs. 1B and 1C).

Laboratory Findings: Calcium, 15.5 and 14.4 mg. per cent; phosphorus, from 2.9 to 5.2 mg. per cent; phosphatase, 6.3 Bodansky units; serum proteins, 8.10 and 7.70 gm. with an A/G ratio of 5.50/-2.60 and 3.00/4.70. Positive Sulkowitch test.

Course in Hospital: A biopsy of an axillary lymph node revealed sarcoid, and the patient was referred for urethane therapy.

CASE II: R. N., a 38-year-old white male, was first admitted to the Johns Hopkins Hospital in 1948 because of calcium deposits in each kidney found during a routine insurance examination.

Significant Symptoms and Signs: After admission, the patient was found also to have severe peripheral arteriosclerosis and calcifications in the cornea and conjunctiva. A tentative diagnosis of hyperparathyroidism was made and the neck and mediastinum were explored surgically, but no parathyroid tumor was found. A cervical lymph node biopsy revealed sarcoid involvement.

Course: In July 1951, neurological signs and symptoms developed. These increased, and the patient was admitted for the last time in October 1951, with right-side weakness, hyperactive reflexes, ankle clonus, and positive Hoffmann and Babinski signs. He was finally discharged as unimproved, with a diagnosis of generalized sarcoidosis with involvement of the left cerebral hemisphere. He died elsewhere in July 1952.

Roentgen Studies: Roentgen examination in 1948 showed nephrocalcinosis and marked peripheral

[1] From the Department of Radiology of the Johns Hopkins Hospital, the Hospital of the University of Pennsylvania, and the University of Maryland Hospital. Accepted for publication in January 1953.

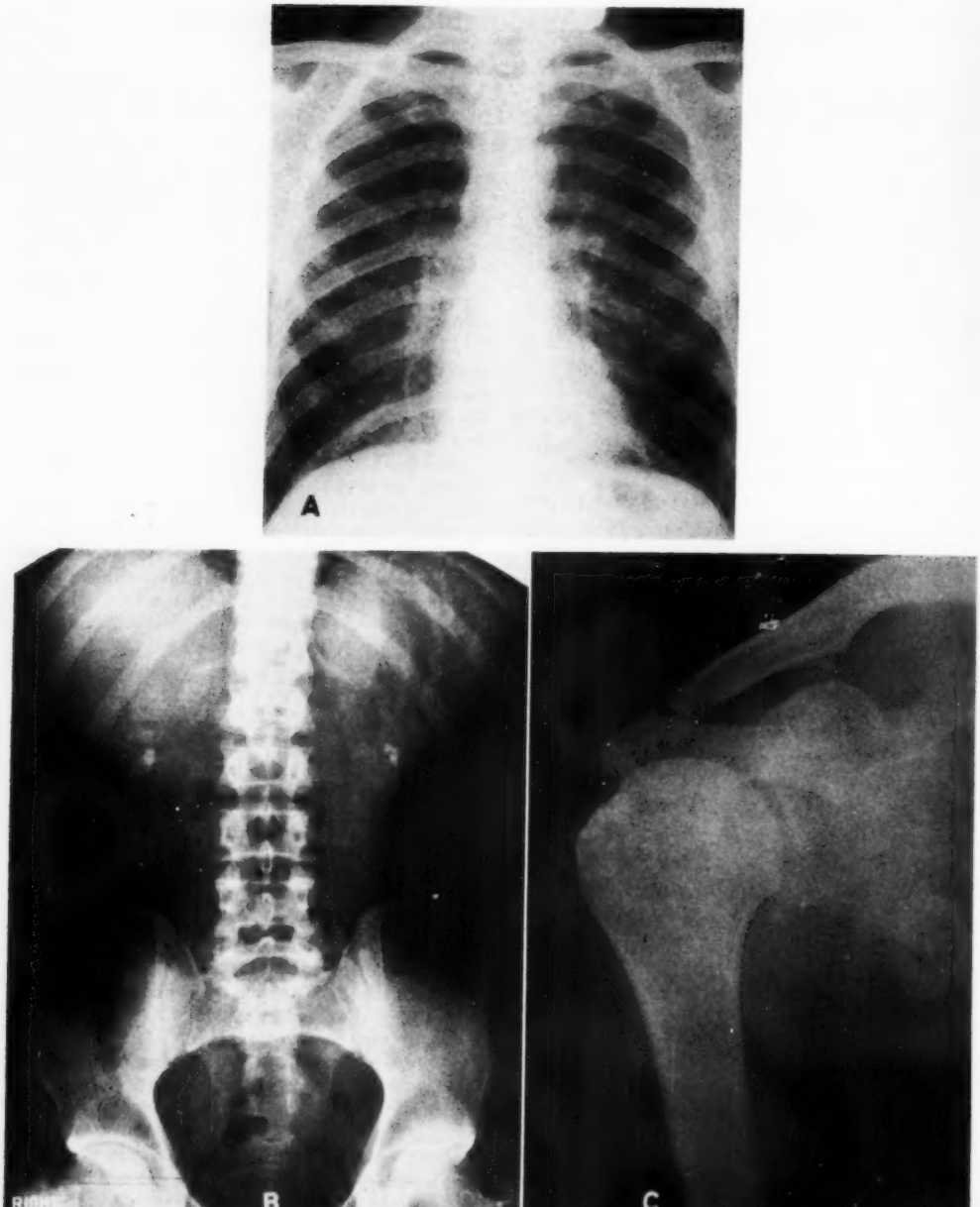

Fig. 1. Case I. A. Chest showing bilateral miliary infiltration. B. Abdomen revealing bilateral diffuse nephrocalcinosis, gas-filled stomach showing prominent rugae, and calcifications in the soft tissues above the right trochanter. C. Shoulder with extensive soft-tissue calcification, without bony demineralization.

arteriosclerosis (Fig. 2A). In October 1951, minimal infiltration in the left upper lobe (Fig. 2B), bilateral nephrocalcinosis (Fig. 2C), and calcifications in the falx and tentorium were demonstrated.

Laboratory Findings: 1948: calcium, 11.3 mg. per cent; phosphorus, 4.5 mg. per cent; phosphatase, 4.1 Bodansky units. 1951: calcium, 11.7 mg. per cent; phosphorus, 3.8 mg. per cent.

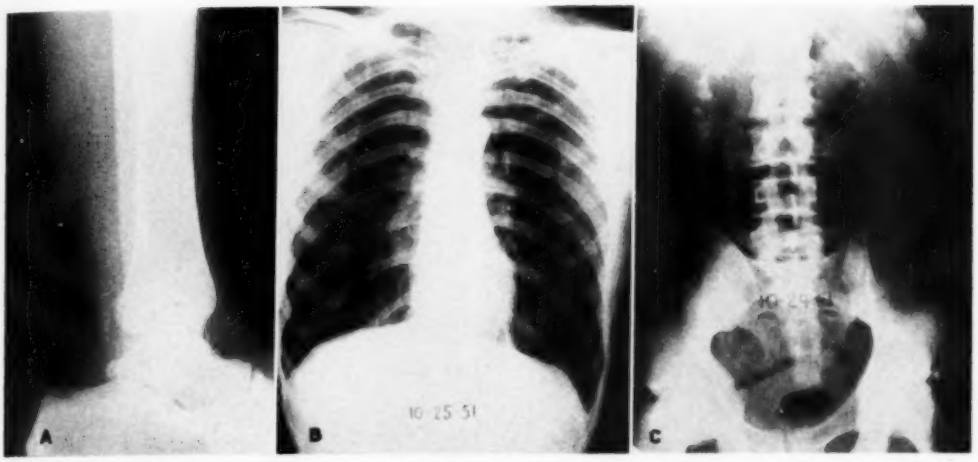

Fig. 2. Case II (38-year-old white male). A. Leg showing marked arteriosclerosis of peripheral arteries. B. Minimal infiltration in the left upper lobe of lung. C. Bilateral diffuse nephrocalcinosis similar to that in Case I. This was demonstrated two years previously but was less pronounced.

Postmortem Studies: Grossly, the kidneys were small, with extensive calcifications in the pyramids and calculi in the calices. Numerous small retention cysts were also present in the cortex. Microscopically, the calcifications were in the interstitial tissues and renal tubules.

CASE III: R. S., a 37-year-old white male, was admitted to the Johns Hopkins Hospital on Oct. 24, 1950, with swelling of the left great toe at the metatarsophalangeal joint.

Chronology of Symptoms: In 1945, while in the Navy, the patient was told that he had pulmonary fibrosis of undetermined etiology. In 1949, he experienced weakness and weight loss following an acute illness characterized by chills, fever, and dysphagia. He was hospitalized at a Veterans Hospital, where a lymph node biopsy revealed sarcoid involvement. He was treated symptomatically and regained his health. In March 1950, his left thumb was amputated because of a chronic swelling, but no tumor was found. In July 1950, the left great toe began to swell and the patient was again hospitalized.

Significant Physical Findings: The left great toe was swollen at the metatarsophalangeal joint, with a palpable mass apparently attached to the bone.

Roentgen Studies: The upper lobe of each lung showed a diffuse infiltration (Fig. 3A). Many punctate calcifications were present throughout both kidneys, and the gastric rugae were prominent (Figs. 3B and C). There was extensive calcification in the bursa area of the left great toe (Fig. 3D).

Laboratory Studies: Calcium, 13.8 mg. per cent; phosphorus, 4.6 mg. per cent; phosphatase, 6.8 Bodansky units; serum protein, 8.5 gm., with an A/G ratio of 4.4/4.1.

Course in Hospital: The mass in the left great toe was excised and found to be calcification within a bursa sac. The patient was discharged as improved. The renal calcifications were thought to be associated with generalized sarcoidosis.

CASE IV: L. S., a 42-year-old white female, was studied at the University of Maryland Hospital in 1951 because of pyuria.

Chronology of Symptoms: The patient's first admission to the hospital was in 1932. At that time, a generalized skin eruption was present, involving the forehead, chest, back, and arms. A diagnosis of sarcoid was made by two dermatologists. On a second admission, in 1936, with the same complaints, a skin biopsy revealed sarcoid lesions. Under gas anesthesia, many of the cutaneous lesions were desiccated. In 1946, a routine chest roentgenogram disclosed a small area of infiltration in the left upper lobe. Clinical studies revealed no evidence of tuberculosis, and the infiltration resolved in one year. The patient was not seen again until 1951, when, as an out-patient, she had urinary studies because of pyuria.

Roentgen Studies: Infiltration demonstrated in the left upper lobe in 1946 (Fig. 4A) resolved in one year. In 1951, small areas of calcification were discovered, scattered throughout the substance of each kidney (Fig. 4B). Moderate hydronephrosis and hydroureter were observed on the right.

Laboratory Studies: A cystoscopic urine specimen from the right side showed 5 to 10 red blood cells and 10 to 15 white blood cells; a specimen from the left showed many red cells. Non-protein nitrogen, 42.5 mg. per cent. Calcium, 16 mg. per cent. Phosphorus, 2.6 mg. per cent. A later blood calcium determination was 9.8 mg. per cent and phosphorus 4.0 mg. per cent.

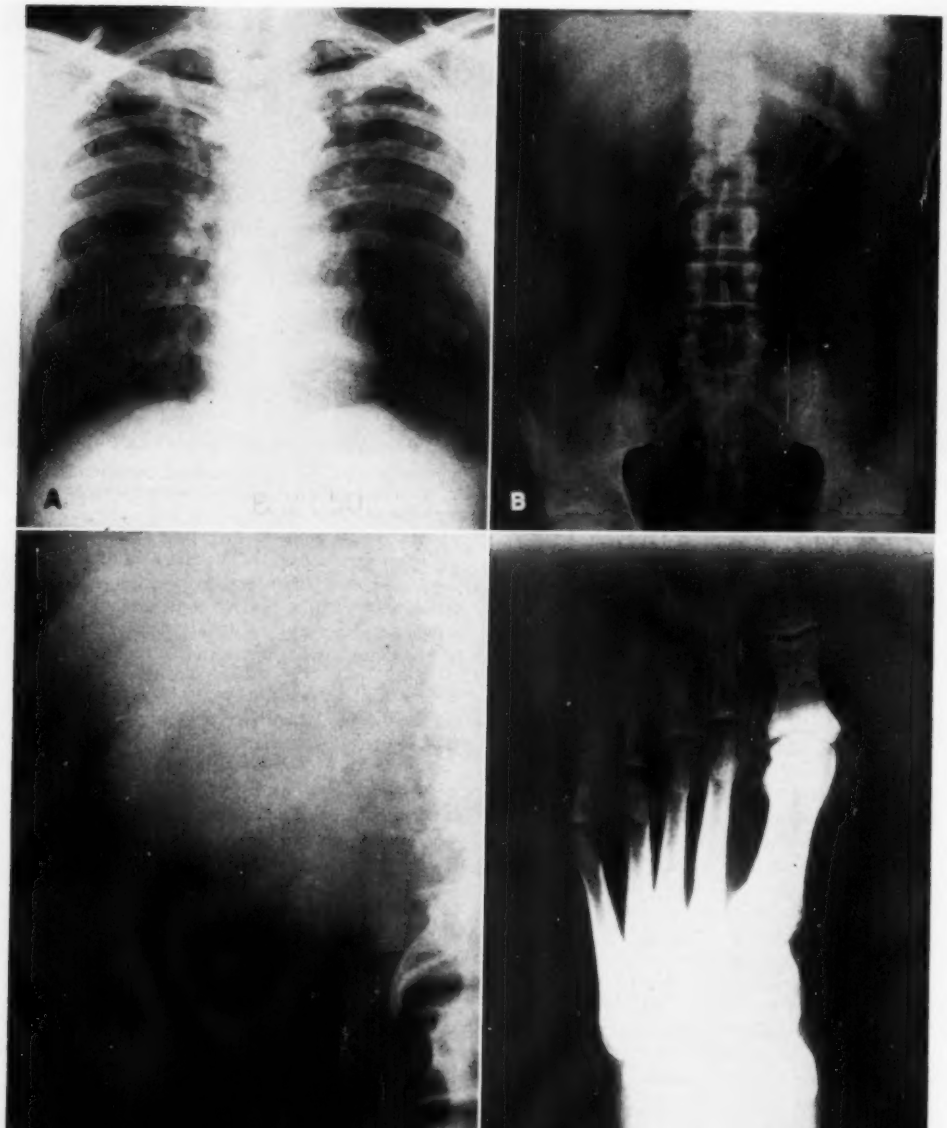

Fig. 3. Case III. A. Marked bilateral pulmonary fibrosis, most pronounced in the upper lobes. B. Calcifications in both kidneys. This is not as pronounced as in the two previous cases. Prominent gastric rugae are again noted. C. Enlargement of right renal area, showing the multiple areas of calcification. D. Calcification in the bursa of the first metatarsophalangeal joint.

Course: The patient remains well. Renal calcifications are present, presumably associated with the sarcoidosis previously proved by skin biopsy.

CASE V: A. T., a 32-year-old colored female, was admitted to the Johns Hopkins Hospital in July 1952, because of increasing renal insufficiency.

Chronology of Symptoms and Signs: The patient was first seen at the Johns Hopkins Hospital in 1946, when a thyroid adenoma was surgically

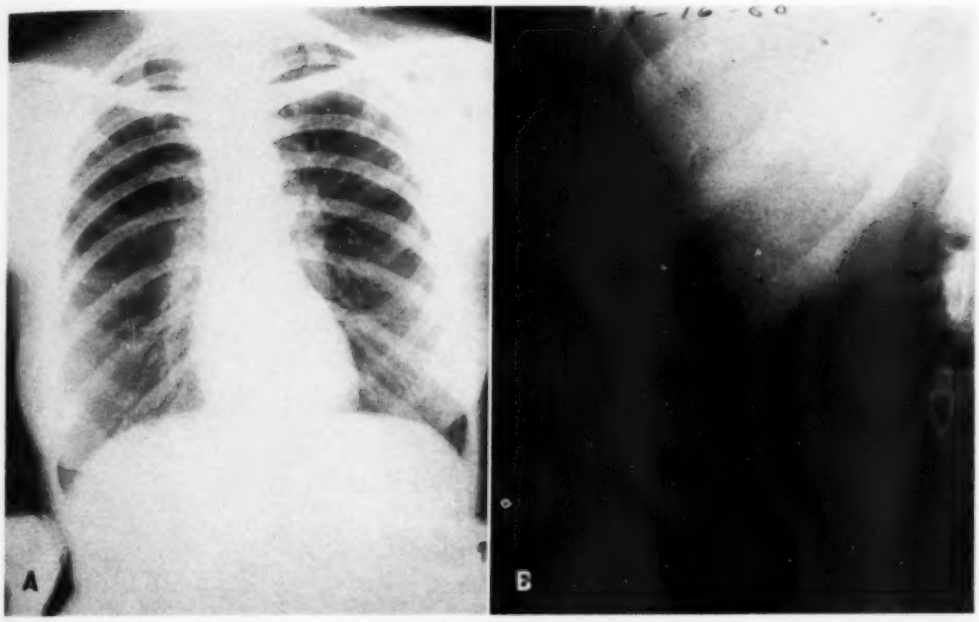

Fig. 4. Case IV. A. Chest showing minimal infiltration behind the left second anterior interspace, which resolved during the course of a year. B. Enlargement of the right renal area demonstrating small calcifications varying from 1 to 5 mm. in diameter, throughout the kidney.

removed. At that time, a large cervical lymph node was also biopsied and sarcoid lesions were found microscopically. Pulmonary changes, increased serum globulin, high calcium and normal phosphorus levels were also compatible with sarcoid. At that time, the blood pressure was normal but renal function was impaired. During the next five years, there was increasing renal insufficiency and hypertension until, on admission in July 1952, the blood pressure was 220/110, with a markedly elevated non-protein nitrogen.

Roentgen Studies: Extensive infiltration was present in each lung (Fig. 5A). A calculus of granular appearance was observed in the upper pole of the left kidney (Fig. 5B). A few small faint granular calcifications were also noted in the right kidney.

Laboratory Findings: Calcium, 11.8 to 12.8 mg. per cent; phosphorus, 7.0 to 10.4 mg. per cent. Non-protein nitrogen, 122 mg. per cent; serum proteins, 8.6 gm., with an A/G ratio of 4.2/4.4.

Course in Hospital: During hospitalization, renal insufficiency increased and the patient died in uremia on Aug. 8, 1952.

Postmortem Studies: Sarcoid lesions were found in the mediastinal, cervical, and periportal lymph nodes, the lungs, and the spleen. Calcifications, suggesting calcification in Schaumann bodies, were present in the sarcoid lesions and in the alveoli of the lungs. Widespread calcifications were also found in the calices, tubular epithelium, and pyramids of the kidneys. A generalized arteriosclerosis of such amazing intensity was observed that the pathologist commented specifically upon it.

CASE VI: I. S., a 34-year-old colored male, was admitted to the Johns Hopkins Hospital in November 1940, because of nocturia, polyuria, polydipsia, ankle edema, a scaling dermatitis, palpable spleen, and a draining sinus in the right axilla.

Chronology of Symptoms: The patient's illness began in 1934 with the development of a bilateral cervical adenopathy, followed by visual disturbances, left facial paralysis, and skin nodules. By 1936, when he was first seen at the University of Maryland, all the findings had subsided except the skin lesions. A skin biopsy several months later at the Baltimore City Hospital revealed typical sarcoid lesions. From 1938, the patient was followed at the Johns Hopkins Hospital. He was admitted in November 1940.

Significant Physical Findings: A scaling dermatitis, a palpable spleen, ankle edema, and a draining sinus in the right axilla were present.

Roentgen Studies: Roentgenograms obtained in 1937 revealed infiltration in the right lung and body destruction in the proximal phalanx of the third toe. In 1940, no change had occurred in the chest, but bilateral nephrocalcinosis was found.

Laboratory Studies: Calcium, 16.5 mg. per cent; phosphorus, 6.1 mg. per cent; serum protein, 7.6 gm., with an A/G ratio of 3.4/4.2.

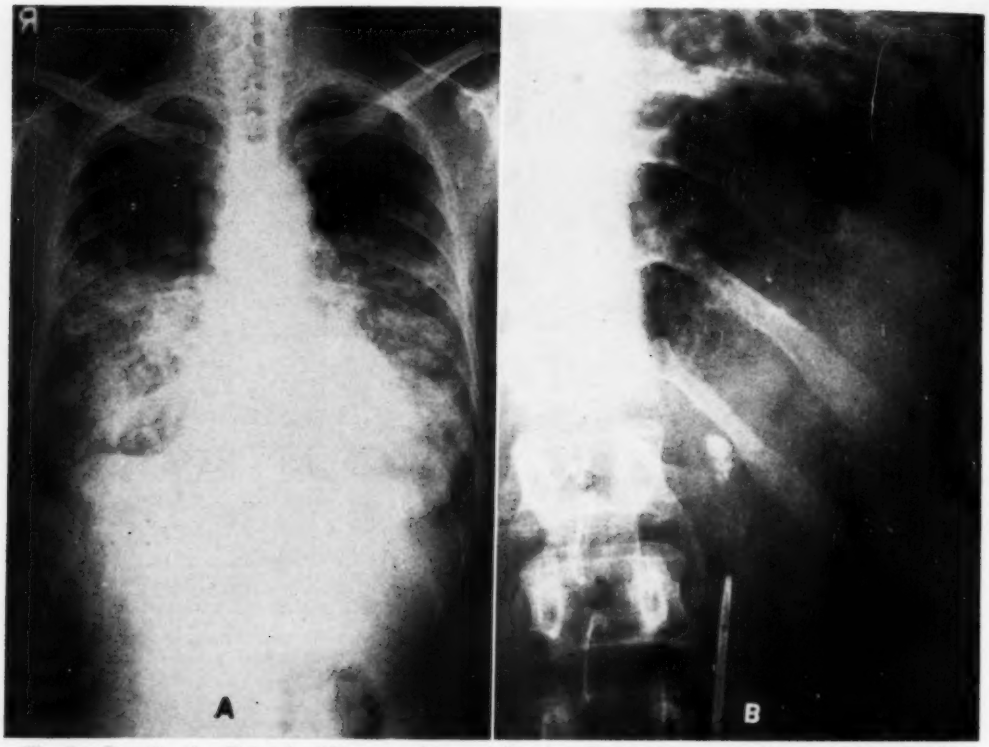

Fig. 5. Case V. A. Extensive bilateral pulmonary fibrosis. B. Enlargement of left renal area showing a large granular calculus in the upper pole of the left kidney. This was found by retrograde pyelography to be in the superior calyx. Several small indistinct areas of calcification were present in the right renal area.

Course in Hospital: Renal failure developed in the hospital and death occurred in December 1940.

Postmortem Studies: Grossly, many calculi were present in the renal calices. Microscopically, sarcoid tubercles were found involving the skin, lymph nodes (Fig. 6A), lungs, liver, spleen, and kidneys. Many renal tubules were occluded by calcified inclusion bodies (Fig. 6B). Caseating tubercles and tubercle bacilli were found in the draining sinus of the right axilla.

CASE VII: G. T., a 45-year-old colored male, was admitted to the Johns Hopkins Hospital in February 1946, because of progressive weakness of the right leg and failing vision.

Chronology of Symptoms: In February 1945, the patient had a low back injury, which was followed by weakness and exertion dyspnea. A few months later, convulsions, aphasia, and failing vision developed.

Significant Physical Findings: On admission, physical examination disclosed evidence of marked weight loss, adenopathy in the axillary and inguinal regions, and a left foot drop, with loss of cutaneous sensation on the dorsum of that foot. Eye examination revealed retinal arteriosclerosis and a left homonymous hemianopsia. The blood pressure was 190/120.

Roentgen Findings: A widespread fibrosis was present in each lung. Nephrocalcinosis was also noted in each kidney.

Laboratory Studies: Calcium, 12.5 to 15.0 mg. per cent; phosphorus, 3.2 to 3.8 mg. per cent; phosphatase, 2.8 to 3.2 Bodansky units; total serum protein, 7.0 gm. per cent, with an A/G ratio of 3.1/3.9. Sulkowitch test, 2 plus.

Course in Hospital: The hypercalcemia led to a suspicion of sarcoid, and an axillary lymph node biopsy was performed. Microscopically, this node showed evidence of healed sarcoid. The patient was discharged with a diagnosis of (1) generalized inactive sarcoidosis with hypercalcemia and nephrocalcinosis and (2) multiple chronic neuropathies.

REVIEW OF LITERATURE

According to Freiman (2), renal involvement occurs in approximately 20 per cent of the cases of sarcoid coming to autopsy, the involvement usually being in the form of a few scattered foci, though occasionally renal calcifications have been described.

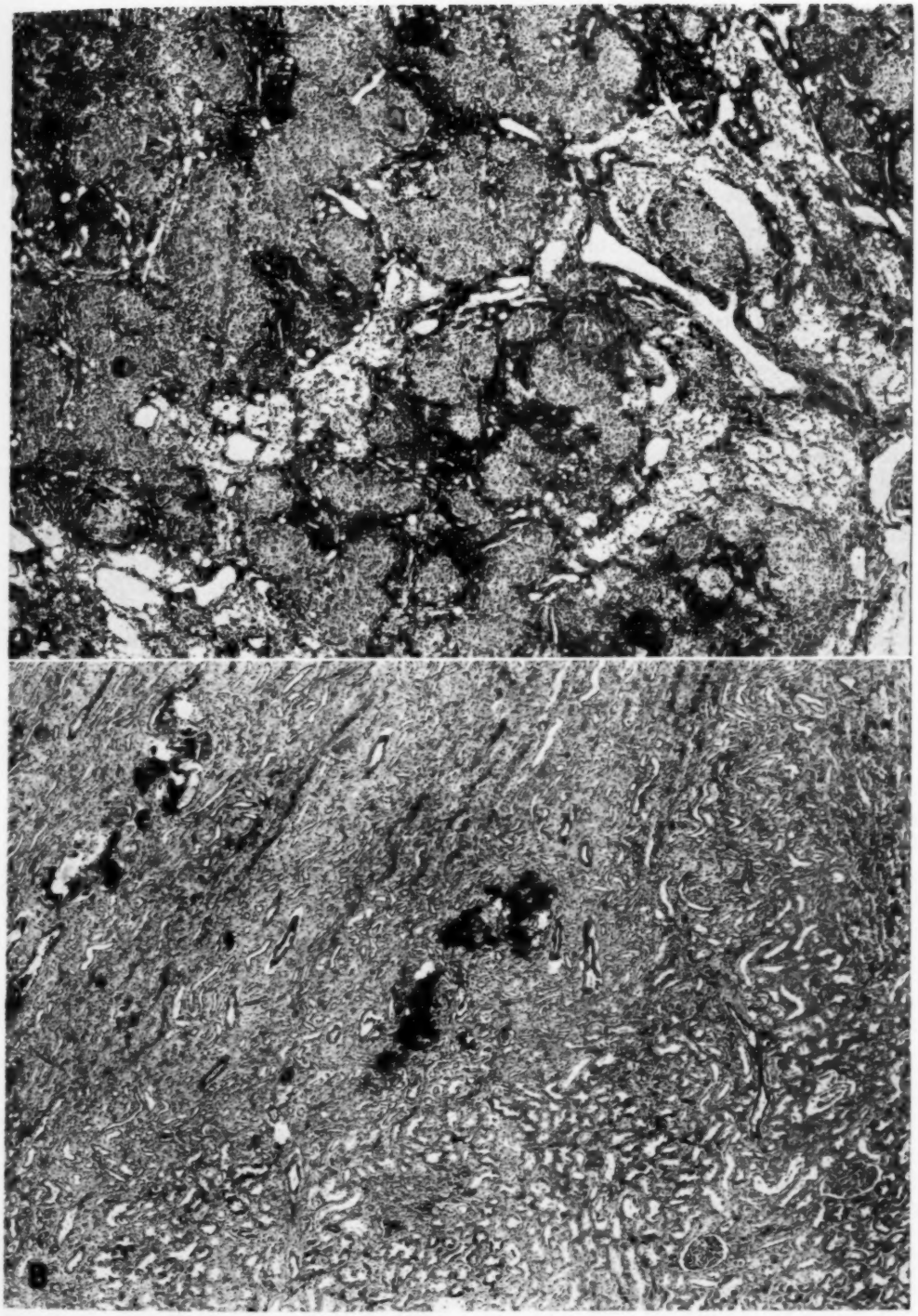

Fig. 6. Case VI. A. Lymph node (×40) revealing non-caseating tubercles of sarcoid.
B. Kidney (×40) showing the large calcifying masses in the collecting tubules.

In 1938, Spencer and Warren (11) in a report of a case with autopsy mentioned that the patient had renal colic due to a calculus. In another case, reported in 1939 by Horton, Lincoln, and Pinner (5), the renal tubules were found postmortem to be replaced by calcified globules.

Van Creveld (12), in 1941, reported 6 cases of sarcoidosis, 5 of which showed hypercalcemia, 2 nephrolithiasis, and 1 periarticular soft-tissue calcifications. Osteoporosis of the bony structures was present in one of the cases with nephrolithiasis.

In 1943, Schüpbach and Wernly (10) reported 4 cases with hypercalcemia, 1 of which also showed bilateral nephrocalcinosis. This patient was a 29-year-old white male who had all the clinical manifestations of sarcoid, including a serum calcium level of 16.3 mg. per cent, plus the radiographic findings of bilateral miliary infiltration in the lungs, bilateral nephrocalcinosis, marked peripheral arteriosclerosis, multiple other soft-tissue calcifications, and prominent gastric rugae. These radiographic findings resemble those in Case I and Case II in our series.

Albright (1), in 1949, reported a case of Boeck's sarcoid with hypercalcemia and nephrolithiasis in a 24-year-old female who had roentgen and laboratory studies consistent with sarcoid. However, in view of an uncertain diagnosis, the parathyroid glands were surgically explored and three normal parathyroids were found.

In 1949, Holt and Owens (4), in their review "Osseous Lesions of Sarcoidosis," mentioned one case with nephrocalcinosis which they attributed to renal sarcoid with secondary infection. They stated that to their knowledge roentgenologically demonstrable nephrocalcinosis in sarcoid had not been previously described.

In 1952, Longcope and Freiman (6), in their excellent monograph on sarcoid, included the case of I. S. (Case VI in our series), who had pulmonary infiltration, bony destruction in a phalanx, and a serum calcium of 16.5 mg. per cent. Renal stones were also present in 3 other patients in their series, and 2 of these had associated hypercalcemia. The stones in all 3 instances were found to be composed primarily of calcium oxalate.

DISCUSSION

The laboratory and radiographic findings in the cases previously reported in the literature correspond closely to those in the 7 cases presented above (Table I).

Hypercalcemia was present in all 7 of our patients with nephrocalcinosis and has been present in most of the cases previously reported in the literature. The genesis of this hypercalcemia is not known at the present time. Harrell and Fisher (3) in their 6 cases with hypercalcemia found the serum calcium elevation considerably higher than could be accounted for by the hyperproteinemia. They thought that the increased serum calcium might indicate involvement of the bone marrow, since Schaumann (9) had pointed out that roentgen studies in no way demonstrated the degree of marrow involvement. Schüpbach and Wernly (10), likewise, were unable to give a satisfactory explanation of calcium elevation but also thought that it was probably the result of sarcoid involvement of the bone marrow. They believed that the increased calcium was in the ionized state because the Q-T interval in an electrocardiogram on one of their patients was shortened, and the albumin-fixed calcium was considered incapable of producing this change. Also, it was the globulin protein fraction which was increased, rather than the albumin fraction. Albright (1), however, was of the opinion that the disordered calcium metabolism was the result not of bone disease *per se* but of disordered blood chemistry. This interpretation was based upon a classical case of sarcoid in which the blood calcium was not materially altered when the calcium intake was increased from 360 to 2,967 mg. per day. Increased urinary calcium excretion, such as was present in 2 of our cases, was further evidence to him that at least part of the elevation of serum calcium was due to an increased ionized calcium fraction

TABLE I: SEVEN CASES OF NEPHROCALCINOSIS ASSOCIATED WITH SARCOIDOSIS

Case	Calcium	Phosphorus	Alkaline Phosphatase	Total Protein	Albumin	Globulin	Sulkowitch Test	Roentgen Findings
1.	15.5	2.9 to	4.7 to	8.10	5.50	2.60	+	Nephrocalcinosis
N. S.	14.4	5.2	5.3	7.70	3.00	4.70		Miliary pulmonary infiltration with question of miliary calcinosis
			6.3					Periarticular calcifications
								Prominent gastric rugae
2.	11.3	4.5	4.1					Nephrocalcinosis
R. N.	11.7	3.8						Pulmonary infiltration, apex left upper lobe
								Extensive arteriosclerosis
								Calcification in falx and tentorium
3.	13.8	4.6	6.8	8.5	4.4	4.1		Nephrocalcinosis
R. S.								Extensive pulmonary infiltration, each upper lobe
								Prominent gastric rugae
								Calcification in bursa
4.	16.0	2.6	2.6					Nephrocalcinosis
L. S.	9.8	4.0						Minimal pulmonary infiltration, apex left upper lobe
5.	10.1 to	7.0 to		8.6	4.2	4.4		Nephrocalcinosis
A. T.	12.6	13.4		7.7	4.0	3.7		Bilateral pulmonary infiltration
6.	16.5	6.1		7.6	3.4	4.2		Nephrocalcinosis
I. S.								Bilateral pulmonary infiltration and hilar adenopathy
								Bone destruction in one phalanx
7.	12.5	3.2	2.8	7.0	3.9	3.1	+	Nephrocalcinosis
G. T.	15.0	3.8	3.2	7.7	3.8	3.9		Bilateral widespread pulmonary fibrosis

rather than to a proteinated fraction. Longcope and Freiman (6) suggested that bone involvement and hypercalcemia occur independently, since no correlation between them could be found in their series. Even though hyperglobulinemia and hypercalcemia are often associated, they thought it improbable that these two findings are directly related, since in one of their cases the peak of hypercalcemia preceded by well over a year the peak of hyperglobulinemia, with the calcium level being near normal by the time the latter peak was reached. While hypercalcemia has been reported in many cases, renal insufficiency has been noted in only a small proportion of these (6).

The blood phosphorus level in our series was usually normal, but in 3 patients it was slightly elevated on at least one occasion. Other observers (2, 3, 6) have found the serum phosphorus to be normal in those cases of sarcoid with an elevated serum calcium. A normal or slightly elevated phosphorus level renders it unlikely that the hypercalcemia in these cases is due to hyperparathyroidism. This is an important observation in differentiating the nephrocalcinosis due to sarcoid from that due to hyperparathyroidism.

Serum alkaline phosphatase levels were elevated in 2 of the 5 cases upon which determinations were obtained. Harrell and Fisher (3) found the alkaline phosphatase increased at some time in 7 of 9 cases in which an alkaline phosphatase determination was done. In their cases, as in ours, there was no correlation with the site or extent of the lesions or with their duration. Longcope and Freiman (6), however, thought that it was not improbable that the increased phosphatase activity may have been occasioned by involvement of the liver, as liver involvement was demonstrated in 2 of 4 cases in one series. In another of their series, all the patients with elevated phosphatase levels showed evidence of marked dissemination of the disease.

The total serum protein was elevated in all 5 of the 7 patients in whom it was determined and was due in each instance to

an increased globulin fraction. This elevated globulin fraction is an important diagnostic finding in sarcoidosis. Longcope and Freiman (6) discussed the elevated globulin fraction and stated: "It is generally agreed that this abnormality in the relationship of plasma proteins characterizes the active stages of the disease, but there is some diversity of opinion as to whether it persists through the quiescent periods."

The roentgen findings in our series were of most interest to us. In all 7 cases there was some radiographic evidence of pulmonary disease. The pulmonary changes varied from a minimal infiltrate to a fibrosis and definite miliary calcinosis. Adenopathy was present in 2 cases. In 1 case (Case V), in which a postmortem examination was performed, calcification was found in the pulmonary lesions in the form of calcified masses suggesting calcification of huge Schaumann bodies. Small discrete nodules of calcification were also present in the alveolar walls, some of which were thought to be within Schaumann bodies while others appeared as linear metastatic calcifications. In Case I (Fig. 1A) the question arose as to whether or not the pulmonary changes were actually those of a miliary calcinosis, as was present in one of Schüpbach and Wernly's cases (10).

The presence of large gastric rugae, quite obvious on a plain abdominal film, is worthy of mention, since it occurred in 2 of our 6 cases (Cases I and III, Figs. 1B and 3B) in which roentgen studies of the abdomen were done and in 1 of Schüpbach and Wernly's 4 cases. This figure seems too high to be considered as merely coincidental. However, since postmortem studies have not been performed on any of the patients with enlarged gastric rugae, it is impossible to know whether or not this is due to sarcoid involvement, but it may be a reasonable assumption, as we have seen 1 previous case with gastric involvement.

Evidence of bone involvement was found in only 1 of the 7 cases (Case VI), in the form of a typical area of cystic destruction in the distal end of a phalanx. This is consistent with the observations of others (1, 6) that there is no definite correlation between the hypercalcemia and bony involvement.

Two patients (Cases I and III) had periarticular soft-tissue calcifications (Figs. 1B and C and 3C). In Case I these calcifications were found about most of the joints and resembled those found in one of Schüpbach and Wernly's cases. Since none of these lesions have been biopsied, the exact location of the calcifications is undetermined. In Case III, however, the calcium deposit was excised and found to be in the bursa sac on the medial surface of the first metatarsophalangeal joint, but no specific sarcoid lesions were found microscopically in the excised tissue. This may have been only a non-specific calcifying bursitis.

Marked arteriosclerosis was present in 2 patients (Cases II and V), both of whom were young. One (Case II) was 38 years of age, with extensive arteriosclerosis observed radiographically (Fig. 2A). The other (Case V) was 32 years of age, and the arteriosclerosis was observed postmortem. The pathologist stated: "arteriosclerosis of amazing intensity for a woman of this age is found scattered throughout the body," but he made no mention of sarcoid lesions being observed in the arteries. There is no doubt, however, that this was in some way connected with the hypercalcemia and other soft-tissue calcifications. Pinner (7) and Ricker and Clark (8) commented upon extensive involvement of the arteries by sarcoid but made no mention of calcification. In perusing the literature, we were unable to find any roentgen evidence of abnormal arteriosclerosis in young patients with sarcoidosis, except for the single case of Schüpbach and Wernly (10).

The most interesting radiographic finding was the nephrocalcinosis and/or nephrolithiasis, which was present in all 7 cases. As has been previously mentioned, hypercalcemia was present in each instance and was undoubtedly the etiological basis for these renal calcifications. Radiographically, these calcifications seem to be

distributed in the pelves, calices, and medullary portions of the kidney (Figs. 1B, 2C, 3B, 4B). This was also verified by the postmortem studies in 3 cases (Cases II, V, and VI). In Case II, gross evidence of calcifications was found in the calices and in the medullary pyramids. Microscopically the calcifications were found in the interstitial tissue, calices, and renal tubules. In Case V, small calcifications were observed in the calices, and microscopically there were widespread metastatic calcifications of the tubular epithelium and large focal areas of calcification in the pyramids. In Case VI, calculi were found in the calices of both kidneys and microscopically there were observed scattered foci of sarcoid tubercles and occlusion of many tubules by masses of calcified material, which appeared similiar to that seen in Schaumann bodies (Fig. 6B). In Cases II and V no mention was made of the calcifications being within sarcoid lesions.

The postmortem studies, done on 3 of our 7 cases, indicate that the soft-tissue calcifications present in association with sarcoidosis occur both in the sarcoid lesions and as metastatic foci in normal tissue.

Some mention should be made of the postmortem evidence of both tuberculosis and sarcoid in Case VI. In both lungs multiple sarcoid tubercles were present; in the apices, they were found in association with cavities which the pathologist believed were tuberculous in origin even though no caseating tubercles could be found or organisms cultured. A lymph node at the site of a draining axillary sinus revealed tubercle bacilli. Because of these observations, the pathologist thought that this was a case where the two diseases coexisted. This is not unusual, as many cases showing findings compatible with both conditions have been reported. Pinner (7) in a review of 42 postmortem examinations found tuberculosis associated with sarcoid in 7 cases. He believed that tuberculosis was a direct transformation from sarcoid. Ricker and Clark (8), in a review of 300 cases of sarcoid, 24 of which came to autopsy, found tuberculosis in 5. Several other single cases of coexisting sarcoid and tuberculous lesions have been recorded.

In the differential diagnosis of the nephrocalcinosis associated with sarcoid, two other important diseases must be considered. Renal tuberculosis produces nephrocalcinosis radiographically indistinguishable from that due to sarcoid. However, demonstration of pulmonary tuberculosis, isolation of the tubercle bacillus from sputum or urine, and characteristic invasive changes in the calices are important diagnostic features. Hyperparathyroidism is the disease with which renal sarcoid is most likely to be confused, as it was in Cases I and II, and Albright's case (1). In each of these instances, the parathyroid glands were explored surgically but no evidence of tumor or hyperplasia was found. However, the diagnostic points in favor of sarcoid are (1) hypercalcemia with a normal serum phosphorus level, (2) hyperproteinemia with an increased globulin fraction, (3) absence of bony demineralization, and (4) elevated serum alkaline phosphatase (1). Other causes of nephrocalcinosis, nephrolithiasis, and hypercalcemia are hypervitaminosis D, acute osteoporosis, multiple myeloma, and metastatic cancer.

SUMMARY

1. Seven cases of sarcoid with nephrocalcinosis have been presented. In 2 of the cases other soft-tissue calcifications were present.

2. All of these cases showed hypercalcemia, although hypercalcemia is not necessarily accompanied by nephrocalcinosis.

3. The calcifications may occur in sarcoid lesions, but are for the most part metastatic. Hypercalcemia is the main factor in the production of these calcifications.

4. Abnormal arteriosclerosis was noted in 2 young patients with sarcoidosis.

5. Absence of bony lesions in the presence of hypercalcemia was noteworthy.

Only 1 of the 7 patients showed roentgen evidence of bone involvement (toe).

6. Patients with nephrocalcinosis should be thoroughly investigated for sarcoid.

We express our appreciation to Dr. Eugene P. Pendergrass and Dr. Ralph Jones of the University of Pennsylvania for allowing us to use Case I in this report.

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ADDENDUM

Since the acceptance of this article for publication, two of us (C.N.D. and J.M.D.) have reviewed another case of sarcoidosis with bilateral nephrocalcinosis. Due to obstruction, a left nephrectomy was performed and pathologic studies of the kidney revealed sarcoid tubercles.

SUMARIO

Nefrocalcinosis Asociada con Sarcoidosis: Presentación y Discusión de Siete Casos

Descríbense 7 casos de nefrocalcinosis asociada con sarcoidosis. Todos los enfermos tenían hipercalcemia, como sucedió también en la mayoría de los casos que constan en la literatura. El fósforo sanguíneo era, en general, normal, observación importante esta para diferenciar la nefrocalcinosis debida a sarcoide de la del hiperparatiroidismo. Las cifras de la fosfatasa alcalina del suero estaban elevadas en 2 de los 5 casos en que se hicieron estas determinaciones. La seroproteína total era alta en los 6 casos en que se determinó, debiéndose esto en todos a aumento de la fracción globulínica.

En todos los 7 casos había signos radiográficos de neumopatía, variando de infiltración mínima a fibrosis y calcinosis miliar bien definida. Dos enfermos mostraron grandes arrugas gástricas. Signos de invasión ósea sólo los hubo en un caso. Dos sujetos tenían calcificaciones del tejido blando periarticular. Observóse arteriosclerosis grave en 2 enfermos de 32 y 38 años de edad, respectivamente. Las calcificaciones renales estaban esparcidas por las pelvis, los cálices y porciones medulares de los riñones.

Los estudios autópsicos indicaron que las calcificaciones de tejidos blandos observadas en asociación con la sarcoidosis se presentan tanto en las lesiones sarcoideas como, y más comúnmente, en forma de focos metastáticos en los tejidos normales.

En los enfermos con nefrocalcinosis, hay que buscar la sarcoidosis. Dolencias que hay que diferenciar son la tuberculosis renal y el hiperparatiroidismo.

Myelographic Demonstration of Cysts of Spinal Membranes[1]

LEWIS G. JACOBS, M.D., JAMES K. SMITH, M.D., and PHILIP S. VAN HORN, M.D.

WE HAVE recently seen two cases in which cysts projecting from the subarachnoid space were filled at myelography. One of these was a congenital extradural meningeal cyst, the other a perineurial cyst. Although the two conditions are unrelated both clinically and pathologically, the somewhat similar pattern of the myelographic findings suggests reporting them together.

CONGENITAL EXTRADURAL MENINGEAL CYST

A rather rare cause of compressive symptoms referable to the spinal cord or its roots is the congenital extradural meningeal cyst. The clinical and roentgenological diagnosis preoperatively is usually cord tumor or disk herniation.

Clinical Features: The similarity of the histories and neurological findings in the reported cases of extradural cysts is striking. The description of the syndrome supplied by Elsberg (4) on the basis of 3 cases of his own and 1 from another clinic leaves little to add. Because of its conciseness and because historically it is the first description of this rare condition, it seems worth quotation:

> "The individual is an adolescent with the history and symptoms of a progressive spastic paraplegia. Pain is absent or is not a prominent symptom. The objective disturbances of sensibility are slight and their upper level is in the mid thoracic region, usually at the sixth or seventh thoracic dermatome. The manometric tests demonstrate a subarachnoid block with the characteristic spinal fluid changes of cord compression. Measurement on anteroposterior x-ray films show that the interpedicular spaces of three or more vertebrae are enlarged. The pedicles of the affected vertebrae are narrowed and atrophic."

Eight cases have been reported since Elsberg's publication. The occurrence of 2 cases first appearing in the fourth or fifth decade of life has shown that the condition is not limited to adolescents. Three of the more recent cases have involved the low thoracic area and extended into the lumbar levels, and in 2 of these the symptoms were referable to the lumbosacral roots rather than the mid thoracic cord, as is more typical.

The occasional occurrence of a remittent course has been remarked by several essayists but is worthy of re-emphasis because of the possibility of confusing this rare but surgically curable condition with multiple sclerosis. One of Elsberg's patients (Case 1) was reported to have had a "remission" lasting eighteen months, followed by a rapidly progressive relapse which led to rehospitalization and surgery. Another (Case 4) had a similar spontaneous remission for about a year. Lehman's (6) Case 1 showed considerable variability both in clinical findings and in spinal fluid dynamics while under observation in the hospital. In the case of Cloward and Bucy (2) an improvement lasting two and a half years followed a period of immobilization on a Bradford frame and a hyperextension body cast. Mixter's case (7) followed the longest course yet recorded. Having its onset at the age of thirteen, it progressed to complete paraplegia, after which the patient slowly improved to the point where he was ambulatory for three years, before symptoms recurred and he was again paraplegic. Such plateaus or remissions in the course have been explained on the hypothesis of an emptying of the cyst through a patent pedicle back into the subarachnoid space, or possibly by an actual rupture of the cyst wall. The symptomatology of cord compression recurs when the cyst refills. Obviously the first explanation can be valid only in those cases in which there is a communication between cyst and subarachnoid space.

Spinal Fluid Findings: Typically extradural meningeal cysts show the spinal fluid changes that may occur with any extradural cord tumor, namely elevated protein, positive Pandy reaction, and

[1] Accepted for publication in March 1953.

TABLE I: CASES OF SPINAL EXTRADURAL CYSTS FROM THE LITERATURE

Case	Age at Onset (Years)	Duration of Neuro. Symptoms	Location	Spinal Fluid Protein (mg.)	Queckenstedt	Clinical Picture	Myelogram	X-ray Appearance of Vertebrae at Level of Cyst	Communicated with Subarachnoid Space	Comment
Elsberg, Dyke & Brewer No. 1	8½	3½ yr.	T6–T9	80	Pos. (block)	Progressive paraplegia; 18 mo. remission with physical therapy	Not diagnostic	Erosion of pedicles; scoliosis	No	.....
Elsberg, Dyke & Brewer No. 2	15	3 mo.	T6–T9	171	Pos.	Progressive paraplegia	Not done	Erosion of pedicles	No	Cyst attached to root T-7
Elsberg, Dyke & Brewer No. 3	15	9 mo.	T6–T9	109	Pos.	Progressive paraplegia	Block	Widening of canal; erosion of pedicles and bodies	No	Cyst attached to root T-6
Elsberg, Dyke & Brewer No. 4	14	1 yr.	T3–T6	?	?	Paraplegia; remission with physical therapy for nearly a year	Not reported	Not available	No	.....
Lehman No. 1	12	3½ mo.	T6–T8	Normal	First neg., later pos.	Rapidly progressive paraplegia, finally complete	Not done	Erosion of pedicles; kyphosis	Yes (one cyst)	Temporary improvement with hyperextension; two cysts found at surgery
Lehman No. 2	16	9 mo.	T6–T10	Normal	Pos.	Progressive spastic paraplegia	Block	Kyphosis; wedging of T-7, T-8, progressive postoperatively	No	.....
Mixter	13	13 yr.	T3–T7	?	Neg.	Paraplegia; long (3-year) remission	Not done	Flattening of vertebral bodies	No	.....
Cloward	40	3 yr.	T10–L5	Normal	Neg.	Progressive paraplegia	Incomplete block	Widening of canal; erosion of bodies	No	.....
Cloward & Bucy	16	4 yr.	T7–T9	44	Slow fall	Progressive paraplegia; remission followed cast in hyperextension	Block	Erosion of pedicles; kyphosis	No	Attached to root T-8

TABLE I: CASES OF SPINAL EXTRADURAL CYSTS FROM THE LITERATURE (*continued*)

TABLE I: CASES OF SPINAL EXTRADURAL CYSTS FROM THE LITERATURE (*continued*)

Case	Age at Onset (Years)	Duration of Neuro. Symptoms	Location	Spinal Fluid Protein (mg.)	Queckenstedt	Clinical Picture	Myelogram	X-ray Appearance of Vertebrae at Level of Cyst	Communicated with Subarachnoid Space	Comment
Peet & Kahn	12	2 mo.	T9–L4	Xanthochromic	Pos.	Difficulty in walking; diminished reflexes; hypesthesia S4–S5	Not done	Widening of canal	?	History of fall shortly prior to onset of symptoms
Swanson & Fincher	40?	Several years	T12–L2	54	Neg.	Disk syndrome; radicular pain; diminished tendon jerks	Normal	Erosion of pedicles	No	.....
Haffner	19	10 mo.	T6–T10	Normal	Neg.	Paraplegia	Block	Widening of canal; erosion pedicles; kyphosis	No	.....
Authors' case	23	9 yr.	T6–T8	54	Slow rise and fall	Progressive spastic weakness; interference with bladder function	Incomplete block T-9, filling of cyst	Erosion of pedicles	Yes	.....

usually some abnormality in dynamics on performance of Queckenstedt's test. As a rule, the protein content is not unduly high; the highest reported was 171 mg. per cent, and it was normal in 3 cases. A positive Queckenstedt sign was obtained in 8 of the 12 cases in which the test was reported.

Roentgen Findings: The roentgenology of congenital extradural meningeal cysts has been rather obscure, and possibly the subject of some misapprehension. Widening of the spinal canal in either diameter or erosion of the pedicles, or both, at the level of the cyst are usual. The vertebrae in the involved area show an epiphysitis, with irregularity of the epiphyseal plates, possibly as a result of circulatory changes secondary to pressure from the cyst, and the kyphosis which is usually present may be secondary to this epiphysitis. This might also explain the tendency to late progress of the kyphosis, even after the removal of the cyst, and the occasional observation of scoliosis. Most of these lesions are thoracic, a few lumbar. None have been reported in the cervical region.

In previous cases, myelography showed no filling of the cyst, but in the majority a partial or complete block was demonstrated. Filling of the cyst with contrast medium is exceptional because most of them do not communicate with the subarachnoid space. The appearance in our case was strikingly suggestive of arachnoiditis. Swanson and Fincher reported a case of traumatic noncommunicating (postlaminectomy) cyst of the meninges in which the needle employed in introducing Pantopaque entered the cyst, which was perfectly outlined (11). This curiosity is unlikely to be often repeated. Ours appears to be the first case in which a communicating cyst filled spontaneously from the subarachnoid space during myelography.

The roentgen differential diagnosis is on the whole unsatisfactory. Many types of neoplasm, as well as traumatic and congenital cysts, produce widening of the spinal canal or erosion of the pedicles. This is also true of a complete block of the

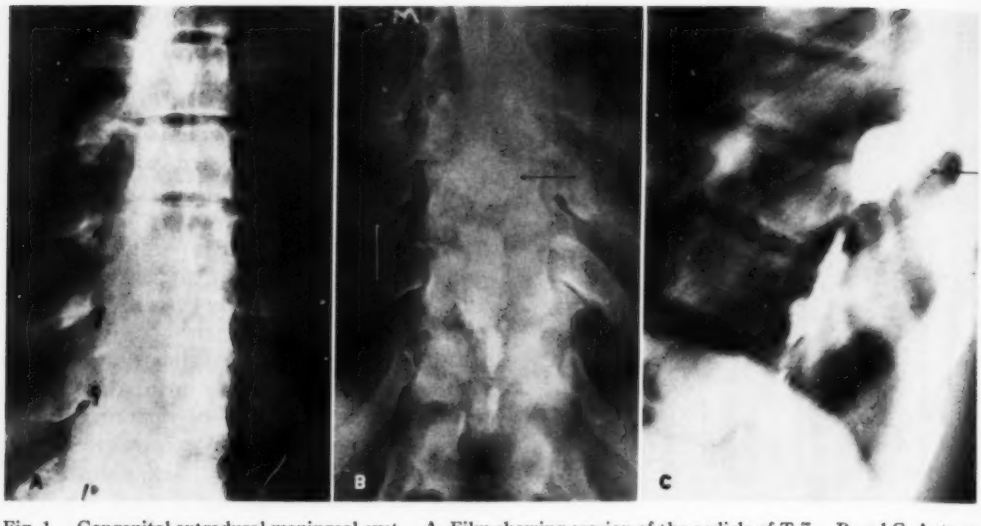

Fig. 1. Congenital extradural meningeal cyst. A. Film showing erosion of the pedicle of T-7. B and C. Anteroposterior and lateral myelograms with arrows pointing to contrast medium in the cyst.

spinal canal, and a good "cap" sign may be observed in both extradural and intramedullary lesions. The presence of incomplete block with an appearance resembling an arachnoiditis is suggestive. With a history in which no cause for inflammatory changes appears, and with physical findings of local rather than diffuse disease, the suggestion becomes much stronger, but hardly conclusive. Only in the rare case in which the cyst fills do we have a conclusive sign, and this must admittedly be exceptional, since most of these cysts do not communicate with the subarachnoid space.

CASE REPORT

A 32-year-old colored male entered the hospital because of a spastic weakness of the lower extremities. In 1943, he first experienced progressive weakness of the left leg, eventually leading to hospitalization and medical discharge from the Army. There was then very little change until the end of 1951, when the weakness became more pronounced and the patient began to drag the right leg as well.

On Feb. 13, 1952, examination on admission to the hospital showed a spastic weakness of both lower extremities, with hyperactive knee and ankle jerks, sustained ankle clonus, bilateral Babinski signs, and absence of abdominal reflexes. There was impairment of sensation below the mid-abdomen, more marked below the hips, bilaterally. Bladder function was fair. The spinal fluid was clear and under normal pressure, with a rather slow rise and slow fall on jugular compression. It contained no cells and showed 54 mg. per cent protein, a positive Pandy reaction, and a negative complement-fixation and gold curve. The blood serology was normal. Roentgenograms of the thoracolumbar spine disclosed minimal arthritis.

The patient refused myelography and was therefore discharged, with instructions to return if he changed his mind. He returned on Sept. 15, 1952, now able to walk only with the aid of crutches, and with clinical findings consistent with cord compression at the 9th thoracic dermatome. Study of the thoracic spine showed a kyphosis with slight wedging of T-7 and T-8, and minimal widening of the canal by pedicle erosion at T-7. Myelography showed an incomplete obstruction at T-9, with only a small trickle of Pantopaque above this level. A round pouch, 2 cm. in diameter, persisted at T-9; lateral and oblique views localized it posterior to the subarachnoid space.

On Oct. 2, 1952, laminectomy of the 6th, 7th, and 8th thoracic vertebrae was performed. A large cyst filled with clear spinal fluid and containing a few droplets of Pantopaque was found compressing the spinal cord between T-6 and T-8, attached to the dura at about the level of T-8 by a thin stalk. It was bound down to the underlying dura by very fine, easily broken adhesions. Normal sensation returned within three days. By the end of the third week, the patient was walking without assistance, though with a spastic gait. At the end of a year he had discarded his cane and was working full time.

PERINEURIAL CYST

Tarlov (13, 14) described the occurrence of perineurial cysts, usually in the sacral roots, both in cadavers and in life as a clinical syndrome simulating intervertebral disk herniation. He stated that myelography would probably not be of diagnostic value, since in his cases the cavity of the cyst was not in continuity with the subarachnoid space. A recent report (Taheri *et al.*, 12) and our own case indicate that this is not always so.

Besides Tarlov's case there have been two or three case reports of perineurial cysts in the lumbosacral region (9, 15). They produce the clinical syndrome of lumbosacral pain, diminished reflexes, and hypesthesia of radicular pattern—in other words the classical history and findings of herniated intervertebral disk. Only at operation is the true pathology disclosed. The case of Taheri and that to be reported here are the only ones in which preoperative diagnosis was possible.

Tarlov raised the question whether perineurial cysts are related to extradural meningeal cysts. He believes that the former arise from a splitting of the nerve root coverings, possibly on the basis of inflammatory change, with eventual distention of the potential space between the endoneurium and the perineurium to form a true cyst. His article contains photographs of serial sections which seem to substantiate this theory of origin. It is noteworthy that in several of the cases of extradural meningeal cyst where careful dissection was possible, the cyst appeared to arise from a pedicle attached near the exit zone of a posterior root. In none of these cases, however, has there been reported any disease of the neighboring nerve root sheath itself, as might be anticipated if the origin was in a perineurial sheath cyst. Moreover, comparison of the histology of the cyst wall in these two types provides evidence that seems to establish their diverse origin. The perineurial cysts consisted of collagenous tissue, frequently showing degenerative change, whereas all of the extradural cysts described in the literature have had a lining made up of a single layer of "pavement" type cells. In the case described by Cloward and Bucy (2), the similarity to the normal arachnoid was further emphasized. One of their photographs shows a cluster of cells arising from this epithelial lining that resembles closely the cell tufts of the arachnoidal villi. There seems little doubt, therefore, that the perineurial cysts arise from a dehiscence in the connective-tissue sheaths lining the nerve roots and that the extradural cysts arise by a gradual ballooning out of the meningeal membranes from a point of congenital weakness near the root exit zone.

Roentgen Findings: The roentgenologic signs in the presence of perineurial cyst are mostly of a negative sort. Bony erosion of the sacrum has been reported in a traumatic cyst but not in a perineurial cyst, probably because of the lateral location of the latter, where pressure changes are unlikely unless the cyst should be of extreme size. The only previous demonstration of such a cyst by myelography is apparently that of Taheri, Riemenschneider, and Ecker (12), who reported a case with operative proof. Tarlov's suggestion of extradural myelography to demonstrate non-communicating cysts is worthy of consideration. The absence of signs of disk herniation on the myelogram is an important differential point, since the clinical picture of the two conditions is identical. A positive preoperative diagnosis can at present be made only in those cases showing filling of the cyst at myelography. The appearance—a round shadow or shadows, with poor emptying or none at all, projecting to one side of the spinal canal in the sacral region—seems pathognomonic.

CASE REPORT

A 57-year-old white male was admitted on April 2, 1951, complaining of chronic low back pain. This had developed in 1918, after the patient had jumped off an embankment, and had been present intermittently ever since. It was aggravated by bending, lifting, or prolonged sitting in one position. In the past two years, the pain had become

Fig. 2. Perineurial cysts. Anteroposterior view of spine obtained after fluoroscopy, showing oil trapped in multiple cysts.

much more severe, shooting down the back of the thigh and into the calf on pressure over either sciatic notch. Coughing now accentuated the pain also. Sensory loss, paresthesias, weakness, and sphincter difficulties were denied.

The patient was a muscular, well developed man. The heart and lungs were not remarkable. There was tenderness to percussion over the sacrum and lumbosacral joints, with marked spasm of the erector spinae group. On the left side, straight leg raising caused pain at 70° of elevation, the calf showed a slight degree of atrophy, the ankle jerk was diminished, and there was slight hypesthesia over the dorsolateral aspect of the foot. Spinal tap yielded clear fluid under normal pressure, with no evidence of a block on the Queckenstedt test, and showing no cells, 35 mg. per cent protein, a negative Pandy reaction, negative complement fixation, and gold curve of 1111000000. The remainder of the laboratory observations, including the blood serology, were within normal limits. Roentgenograms of the lumbar spine showed a moderate degree of hypertrophic osteoarthritis, with lateral bridging of L-2 and L-3. Pantopaque myelography showed a free flow of the contrast medium and no filling defect in the column of oil. There was a cyst-like projection about 1 cm. in diameter to the left of the sacral canal, and two smaller areas at either side of the next lower segment.

On May 25, 1951, a laminectomy was performed on L-4 and L-5. It was noted that L-5 was markedly unstable and there was redundancy of the ligamentum flavum. No disk herniation was found, but on the first two sacral roots on the left there were small cysts about 3 cm. out from the dural sac, which contained clear spinal fluid. Postoperatively the patient was relieved of his radicular pain. Three months later he had no complaints.

CONCLUSIONS

Two cases of cysts projecting from the subarachnoid space—one of the meninges and one of the nerve sheaths—are reported in which myelographic filling of the cysts took place, demonstrating the possibility of a positive roentgenologic diagnosis.

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SUMARIO

Observación Mielográfica de Quistes de las Membranas Raquídeas

Preséntanse 2 casos en que, con la mielografía, se llenaron quistes de las membranas raquídeas que proyectaban del espacio subaracnoideo, permitiendo así hacer el diagnóstico roentgenológico. Uno de ellos era un quiste meníngeo extradural congénito y el otro un quiste perineurial.

En los casos comunicados anteriormente, la mielografía no había revelado henchimiento de los quistes meníngeos extradurales, dado que la mayoría de éstos no se comunican con el espacio subaracnoideo. Según parece, no se ha descrito más que un solo caso de observación mielográfica de un quiste perineurial. En este estado, una sombra o sombras de forma redonda, con vaciamiento inadecuado o nulo, que proyecten a un lado del conducto raquídeo en la región sacra, parecen ser patognomónicas.

Creeping Eruption Associated with Transient Pulmonary Infiltrations[1]

EDMOND H. KALMON, M.D.

CREEPING ERUPTION, known also as endemic cutaneous helminthiasis and larva migrans, is endemic in the coastal areas of the southeastern United States. While it is usually recognized as a purely cutaneous disease, it may be a causative agent of Loeffler's syndrome, as in the following case, observed in Oklahoma.

CASE REPORT

A 23-year-old white male worked daily from July 6 to 11, 1951, on the cooling system of an air-conditioning unit under a house, where stagnant water had been standing for several months. The family dog had spent much time in this area. On July 8, the patient noticed multiple papular lesions on his legs, arms, and back, which by the following day had become erythematous and pruritic. The typical migrating burrows of creeping eruption soon appeared. All lesions continued to grow worse, and many became secondarily infected. An annoying non-productive cough developed, occurring in paroxysms, and there was an associated mild dyspnea.

The patient was admitted to Wesley Hospital on July 16, 1951. The only findings of significance other than the extensive skin lesions were bilateral wheezing and crepitant râles. The following day all skin lesions were sprayed with ethyl chloride, under sodium pentothal anesthesia. There was a low-grade fever, 100.5–101° F., daily for about seven days. The moderately severe cough continued for approximately two weeks and was treated with gantrisin, penicillin, and later aureomycin. Demerol was required for the painful skin lesions. The first roentgen examination of the chest, on July 23 (Fig. 1), showed widely scattered patches of bronchopneumonia in each lung. On July 26 (Fig. 2), the left lung had almost cleared, as had the right upper lung field, but the right base showed more extensive infiltration. On July 29 (Fig. 3), most of the lung lesions had disappeared, although there was a new area of pneumonitis in the right lower lung field laterally.

On July 17, the white cell count was 13,750, with 66 per cent neutrophils and 3 per cent eosinophils. On July 23, the corresponding values were 17,400, 74 per cent, and 11 per cent. The sputum was examined for eosinophils and ova on July 23 and 24, with negative results. On July 28 and 30, stool examinations showed numerous ova morphologically resembling the ova of *Ancylostoma*. On July 30, the white cell count was 12,950, with 27 per cent eosinophils. On this day the patient received 3 c.c. of tetrachloroethylene orally, preceded and followed by magnesium sulfate. He was discharged on the eighteenth hospital day.

Following discharge it was necessary to spray a few still viable migrating larvae with ethyl chloride. On March 29, 1952, the patient was feeling well and had regained the 40 pounds he had lost. He still complained of occasional paroxysms of non-productive coughing. His stools at this time showed no ova, and the lungs were clear roentgenologically. On Aug. 2, 1952, he had no complaints, and he had not been troubled by a cough for several months.

LOEFFLER'S SYNDROME

Loeffler's syndrome is characterized by (1) transitory and changing pulmonary infiltrations, (2) eosinophilia of the peripheral blood and often of the sputum, and (3) a relatively benign clinical course, which may be entirely afebrile or show only mild temperature elevations. The patients have an annoying cough, which is usually non-productive. The physical findings in the chest are few, consisting mainly of occasional moist râles. The roentgenographic changes in the lungs are, as a rule, more extensive than would be expected from the clinical findings. Serial films of the chest are necessary to show the transitory nature of the pulmonary lesions. The shadows usually begin to disappear in six to eight days and may be entirely gone a few days later.

The etiology of Loeffler's syndrome has not been firmly established. It is probably an allergic response by the lungs to various antigenic substances. The fact that the condition has a definite seasonal trend, being more prevalent in July and August, supports this idea. The various causative agents which have been suggested are privet pollens, *Endamoeba histolytica*,

[1] From the Department of Radiology, Wesley Hospital-Oklahoma City Clinic, Oklahoma City, Oklahoma. Accepted for publication in February 1953.

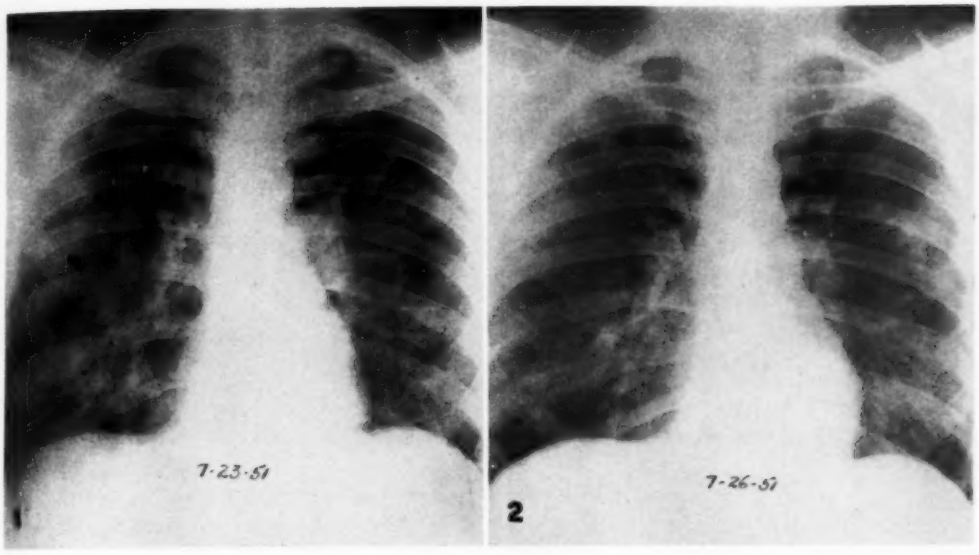

Fig. 1. July 23, 1951: Widely scattered small irregular areas of infiltration in each lung.
Fig. 2. July 26, 1951: Areas of infiltration have cleared somewhat, although there are new patches overlapping the left midlung field.

Ascaris lumbricoides, *Trichuris trichiura*, *Strongyloides*, *Taenia saginata*, brucellosis, azosulfamide, *Necator americanus*, and creeping eruption.

Wright and Gold (26), in 1945, were the first to describe the association of cutaneous helminthiasis with Loeffler's syndrome. They reported 9 cases with pulmonary infiltration in a group of 26 patients with creeping eruption. The pulmonary lesions usually did not appear before the seventh day after the skin was invaded. These same authors (27) a year later added 17 more cases, making a total of 26 with pulmonary infiltrations from a larger group of 76 cases of larva migrans. Horton (16), in 1950, reported one instance of Loeffler's syndrome in a group of 21 patients with creeping eruption. Pollock (22), in 1951, described typical transient lung infiltrations combined with cutaneous helminthiasis in a plumber. No additional reports of this association could be found.

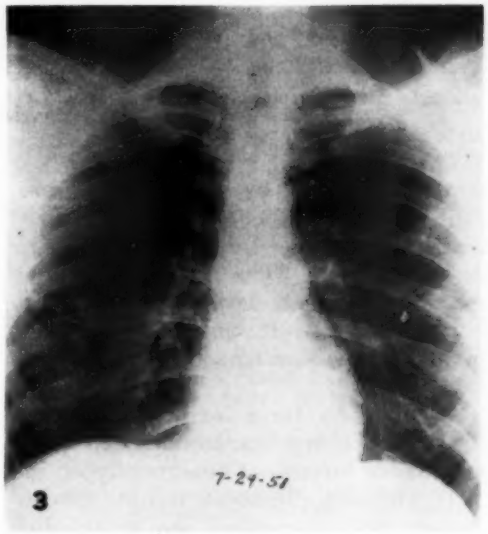

Fig. 3. July 29, 1951: The pulmonary lesions have almost entirely cleared except for some additional new lesions overlapping the right fourth anterior interspace.

CREEPING ERUPTION

The creeping eruption prevalent in the southeastern United States has been generally considered as a simple skin lesion. It is characterized by tortuous, elevated, migrating burrows or tunnels in the skin (Figs. 4 and 5) with intense itching. Moderate cellulitis due to secondary infection is common.

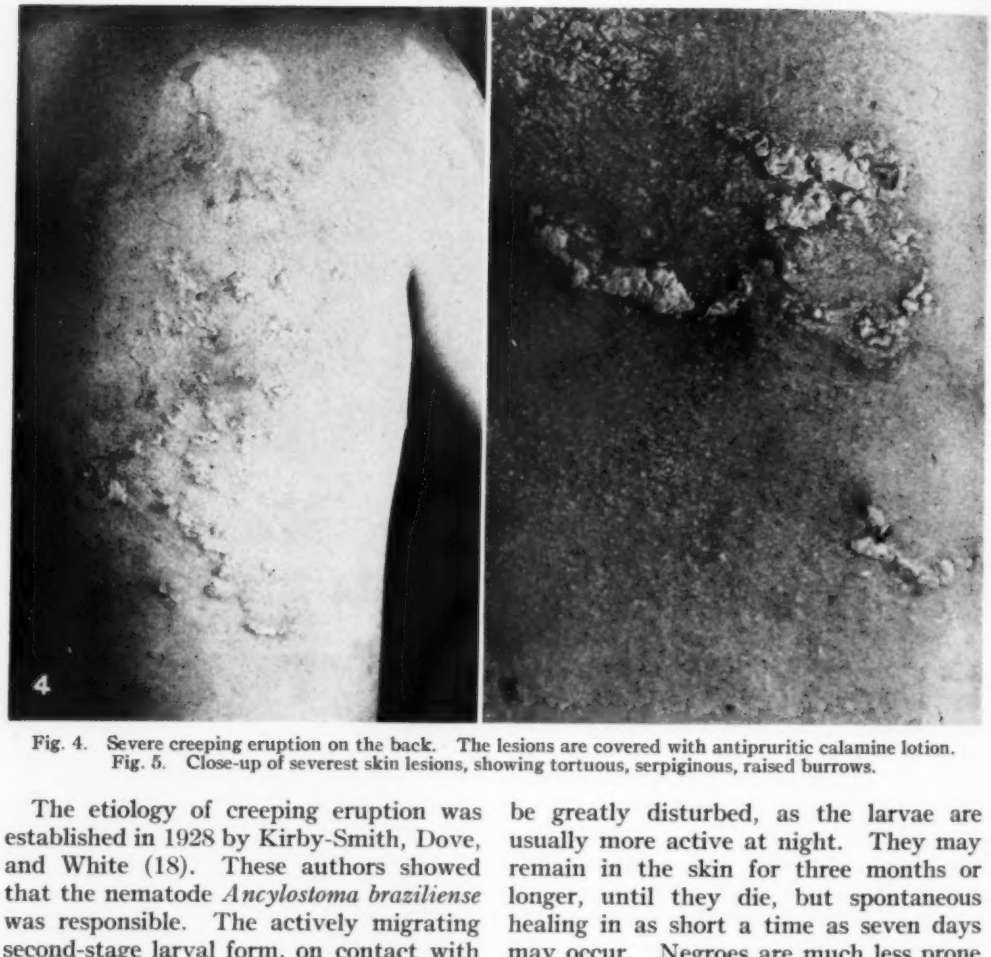

Fig. 4. Severe creeping eruption on the back. The lesions are covered with antipruritic calamine lotion.
Fig. 5. Close-up of severest skin lesions, showing tortuous, serpiginous, raised burrows.

The etiology of creeping eruption was established in 1928 by Kirby-Smith, Dove, and White (18). These authors showed that the nematode *Ancylostoma braziliense* was responsible. The actively migrating second-stage larval form, on contact with human skin, loses its chitinous sheath and penetrates the skin as a third-stage larval form.

Infection by these larvae occurs most frequently on beaches, around sand boxes, and under houses. Consequently, swimmers, children, plumbers, termite exterminators, and carpenters are most often infected. Hot, moist weather plus a sweating skin favor infection. A small pruritic papule develops at the site of penetration within a few hours. About twenty-four to seventy-two hours after this, serpiginous, elevated, reddish-brown burrows appear. These lesions advance at the rate of one-fourth to one or more inches in twenty-four hours. Sleeping may be greatly disturbed, as the larvae are usually more active at night. They may remain in the skin for three months or longer, until they die, but spontaneous healing in as short a time as seven days may occur. Negroes are much less prone to contract creeping eruption than Caucasians.

COMMENT

Some nematodes, such as the hookworm, *Necator americanus*, cause human infestation by the following devious route: (*a*) penetration of the skin by an active larval form, (*b*) passage into lymphatic channels and then into the venous blood stream, (*c*) passage through the heart into the pulmonary artery to the lungs. The larvae are unable to pass through the pulmonary capillaries and are filtered out. At this stage, bronchitis and transient bronchopneumonia may be found. The larvae may burrow through the alveolar

walls, enter the bronchi, and crawl up the trachea. They are usually swallowed after reaching the epiglottis and establish themselves in the small bowel.

Wright and Gold (27) made 441 stool examinations in their series of 76 cases of creeping eruption and were unable to find a single instance of *Ancylostoma* ova in the feces. Shelmire (23) repeatedly cultured the stools of 7 spontaneously infected and 16 experimentally infected patients. None of these showed intestinal infestation with *Ancylostoma braziliense*. Hitch (13) examined the stools of 12 of his patients and found ova in none. Recently Muhleisen (21) reported the first recorded instance of the demonstration of *Ancylostoma* larvae in the sputum of a patient with creeping eruption. Yet no ova were present in the stools.

It is unfortunate that the *Ancylostoma* ova found in the feces of the case reported here were not cultured and identified unquestionably. Had we been able to prove beyond doubt that they were *Ancylostoma braziliense*, this would have constituted strong evidence for transpulmonary larval migration as the causative factor of the lung infiltrations. As it is, only presumptive evidence is offered that the larval forms of creeping eruption may traverse the lungs. Muhleisen's report offers direct evidence of transpulmonary migration, but roentgenograms of the lungs of his patient on three occasions showed no infiltration.

It is possible that the larvae can enter the lungs and die there, thus failing to reach the intestinal tract. Pulmonary lesions would thus be produced, though perhaps less fleeting or transient than in most cases. Many observers feel that the most likely explanation of the pulmonary infiltration is that the larvae, remaining subepidermal, elaborate an exotoxin which sensitizes the host, and that the lung reacts as the shock tissue to the blood-borne antigens.

SUMMARY

1. Attention is called to the fact that creeping eruption is occasionally associated with transient pulmonary infiltrations and eosinophilia. One such case, occurring in Oklahoma, is reported. The highest eosinophil count in this patient was 27 per cent. No eosinophils were found in the sputum.

2. *Ancylostoma* ova were found twice in the patient's stools, offering strong presumptive evidence that the larval forms can traverse the lungs to produce the fleeting pulmonary infiltrations associated with Loeffler's syndrome.

3. Annoying paroxysms of coughing were a prominent feature in this case, persisting as long as nine months after the skin and pulmonary lesions had cleared.

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SUMARIO

Larva Migrans Asociada con Infiltraciones Pulmonares Pasajeras

En este caso, una erupción serpiginosa debida al *Ancylostoma braziliense* estaba unida con pasajera infiltración pulmonar y eosinofilia (síndrome de Loeffler). No se encontraron huevos del anquilostoma en el esputo, pero sí se obtuvieron dos veces de las defecaciones, lo cual aporta poderosa prueba presuntiva de que las formas larvales del parásito atraviesan los pulmones, produciendo allí las lesiones transitorias del síndrome de Loeffler. La fórmula eosinófila más alta observada durante la evolución de la enfermedad fué de 27 por ciento.

Molestos accesos de tos constituyeron una característica destacada del caso presentado, continuando hasta nueve meses después de la desaparición de las lesiones cutáneas y pulmonares.

Report of a Case of Osteonephropathy with Vascular Calcification in Infancy[1]

EUGENE P. PENDERGRASS, M.D., and FRANK P. BROOKS, M.D., Sc.D.

THE CASE TO BE described here not only illustrates the roentgen findings in osteonephropathy or "renal rickets," but is of particular interest because of the early age at which the bone changes and vascular calcification became manifest. Although this patient was studied before current clearance studies of renal function were available, the interesting clinical and roentgen aspects of the case seemed sufficient to warrant its report.

We have reviewed 14 cases from the literature (1, 2, 4, 5, 6, 7, 9, 10, 11, 12, 13) exhibiting the combination of chronic renal disease, roentgen findings in long bones and skull consistent with osteonephropathy, and arterial calcification demonstrated either roentgenographically or at autopsy. Tables I and II summarize the clinical, laboratory, and roentgenologic findings in these cases. The patients varied in age from four weeks to twenty-one years and two months; 8 were females and 7 males. There was no familial history of renal disease. In all there was evidence of severe renal disease with azotemia. The majority showed acidosis as measured by the serum carbon dioxide values, and also anemia. Four had hypertension. Serum calcium levels were variable. In all except one, the serum phosphorus levels were elevated. Phenolsulfonphthalein excretion tests showed impaired function in all patients who had the test performed. Seven were considered to have evidence of renal infection and 3 had pyuria. Five gave a history of vitamin D administration. In all patients there were roentgen changes in the long bones.

Parsons and Teall (8, 14) described two types of bone changes in renal rickets. The first was indistinguishable from ordinary rickets; the second was more distinctive and was characterized by swelling of the epiphyses, thickening of the trabeculae, subperiosteal erosions, and a stippling or moth-eaten appearance in the metaphysis. The term "woolly," usually applied to the latter, seemed ideally descriptive. Patients with this type of change in the long bones also occasionally showed changes in the skull resembling Paget's disease. According to Parsons, the "woolly" type represented an advanced form of the disease, although he had never followed a patient from the rachitic to the more florid "woolly" stage. Microscopic study of the bone in one of his cases was reported to show changes compatible with ordinary rickets. Other authors have described the microscopic findings as compatible with osteitis fibrosa cystica (10).

Nine of the 14 patients in the collected series exhibited roentgen changes in the skull resembling Paget's disease or hyperparathyroidism (3). Some showed multiple round areas of increased density, others a granular osteoporosis. These changes were usually, but not invariably, associated with the "woolly" type of change in the long bones.

The least common of the roentgen manifestations of osteonephropathy is the calcification of the arteries of the soft tissues. Calcification of soft tissues other than the arteries was present in 12 patients, involving the subcutaneous tissues, dura, lungs, endocardium, peritoneum, kidneys, heart, and muscles. Histopathological changes in the arteries included proliferation of the subintimal connective tissue and widespread degeneration of the tunica media with massive calcification.

Ten of the patients came to autopsy: 5 showed evidence of chronic pyelonephritis, 2 had chronic glomerulonephritis,

[1] From the Department of Radiology, Hospital of the University of Pennsylvania, Philadelphia, Penna. Accepted for publication in March 1953.

TABLE I: FOURTEEN CASES OF OSTEONEPHROPATHY WITH VASCULAR CALCIFICATION

Investigator	Age	Sex	Hypertension (above 140/90)	Familial History Renal Disease	Vitamin D Therapy	Glycosuria	Pyuria	Renal Infection	Hematuria	Blood Urea Nitrogen*	Blood Non-Protein Nitrogen	Blood Carbon Dioxide	Blood Phosphorus	Blood Calcium	Blood Chlorides	Blood Cholesterol
Andersen and Schlesinger (1)	6 wk.	M	−†	0	+	0	+	0	+	56.7–71.7 mg./ 100 c.c.	47–120 mg./ 100 c.c.	8.5–38.5 mEq./ liter (serum)	6–12 mg./ 100 c.c. (serum)	8–11 mg./ 100 c.c.	85.7–108.8 mEq./ liter (serum)	210 mg./ 100 c.c. (serum)
	4 wk.	M	0	0	+	0	0	0	0	...	68.4–125 mg./ 100 c.c.	16–41.4 vol. %	6.4–11.3 mg./ 100 c.c. (serum)	6.5–9 mg./ 100 c.c. (serum)	...	177 mg./ 100 c.c. (serum)
Bass and Pakter (2)	12 yr.	F	0	0	0	0	0	+	0	35 mg. %	...	38–43	4.0–9.2	9.8–12.1	365–665	305–370
Hild (4)	1 yr.	F	−	0	0	0	0	0	0	178*	176 mg./ 100 c.c.	27.4 vol. %	10.5–12.3 mg.	9.2–10.1 mg./ 100 c.c. (serum)	...	...
Karelitz and Kolomoyzeff (5)	6 yr.	F	0	0	+	0	0	0	0	54–181 mg.	...	27–41 vol. %	4.2–12 mg.	5.0–12.4 mg./ 100 c.c.	480–585 mg.	200–540 mg.
Lightwood (6)	2¼ yr.	F	+	0	+	0	0	0	+	169 mg./ 100 c.c.	...	...	6.68 mg. %	11 mg. % (serum)	...	196 mg./ 100 c.c.
Menville, *et al.* (7)	6 yr.	M	+	0	+	0	0	+	0	...	120–200	18	3.1	10.5, 10.6	...	261
Platt and Owen (9)	18 yr.	M	+	0	0	0	0	0	0	205 mg./ 100 c.c.	333–400 mg./ 100 c.c.	...	15.1 mg./ 100 c.c.	6.7 mg./ 100 c.c. (serum)	...	179 mg./ 100 c.c.
Shelling and Remsen (10)	17 yr.	M	0	0	0	0	0	0	0	...	153–364 mg. %	27–48 vol. %	7.7–10.5 mg. %	9.3–9.9 mg. %	76–113 c.c. (Cl N/10)	208 mg. %
Smyth and Goldman (11)	14 yr.	M	0	0	0	0	0	+	0	...	80.0–333	49.3–49.6 (plasma content)	10.9–16	10.5–11.9	455–456.3 (whole blood)	...
Smyth and Yeazell (12)	21 yr. 2 mo.	F	+	0	0	0	+	+	0	...	59.9–191 mg. %	21.0–72 vol. %	3.2–10.41 mg. % (serum)	5.9–11.49 mg. % (serum)	473–643 mg. % (plasma)	158–276 mg. % (plasma)
Sussman and Poppel (13)	21 yr.	M	−	0	0	0	+	+	+	85 mg.	...	...	8.5 mg./ 100 c.c. (serum)	10 mg.	...	390 mg.
	18 yr.	F	−	0	−	0	0	+	0	120 mg.	...	...	8.0–10.5 mg.	10.4 mg.	...	180 mg./ 100 c.c. (serum)
	14 yr.	F	−	0	−	0	0	+	0	125–178 mg.	...	...	6.7–8 mg.	1.7–12 mg.	...	...

* In many cases source was defined only as blood and no units of measurement given. † − = no mention; 0 = absent; + = present.

TABLE II: FOURTEEN CASES OF OSTEONEPHROPATHY WITH VASCULAR CALCIFICATION

(Same cases as in Table I)

Investigator	Secondary Anemia	Phenolsulfonphthalein 2 Hr. Excretion	Roentgen Changes in Long Bones	Roentgen Changes in Skull	Calcification Elsewhere	Autopsy	Parathyroid Hyperplasia	Pathologic Diagnosis of Kidneys at Autopsy
Andersen and Schlesinger (1)	+*	−	+	0	+	+	+	Congenital hypoplasia
Bass and Pakter (2)	+	−	+	−	+	+	+	Congenital cystic disease
Hild (4)	+	<5%	+	+	+	0	−	....
Karelitz and Kolomoyzeff (5)	+	<3%	+	−	0	0	−	....
Lightwood (6)	+	Trace	+	+	+	0	−	....
Menville, *et al.* (7)	−	−	+	+	+	+	0	Interstitial fibrosis
Platt and Owen (9)	+	6%	+	+	+	+	+	Chronic interstitial nephritis
Shelling and Remsen (10)	+	−	+	−	+	+	0	Interstitial nephritis
Smyth and Goldman (11)	+	<5%	+	+	0	+	+	Chronic pyelonephritis
Smyth and Yeazell (12)	+	3–7%	+	+	+	+	+	Chronic glomerulonephritis
Sussman and Poppel (13)	−	1–58%	+	+	+	+	+	Chronic pyelonephritis
	−	−	+	+	+	0	−	....
	−	−	+	+	+	+	+	Chronic glomerulonephritis
	−	<5%	+	−	+	−	−	....

* + = present; 0 = absent; − = no mention.

2 had cystic disease, and 1 had congenitally hypoplastic kidneys. In 9 cases, the parathyroid glands were examined at autopsy: 7 showed hyperplasia and 2 were considered normal.

It is evident that all patients had severe renal disease of an inflammatory or congenital nature and that secondary parathyroid hyperplasia was a factor to be considered in the mechanism of the bony changes and metastatic calcification in most patients.

REPORT OF A CASE

R. W., the second female child of healthy white parents, was first seen at eight months of age with deformed extremities. Her birth had been spontaneous, but she was said to have been dyspneic and cyanotic. She weighed five and one-half pounds. She was started on orange juice at three weeks of age and on cod liver oil when five or six weeks old. Her development had appeared normal until two months of age, when her parents noted weakness in her head movements and she began to vomit at mealtime. After two months the vomiting ceased, but the bones of the left wrist appeared prominent. The forearm was placed in a cast for several weeks, and when this was removed, bowing was noted. Roentgen examination showed acute rickets. The child failed to respond to treatment—40 drops of Percomorph oil and 10 drops of Drisdol daily—and was therefore referred to the Hospital of the University of Pennsylvania for study. She had had no serious illnesses nor any of the acute exanthemata.

On physical examination it was found that the child could not walk and that none of her teeth had erupted. She was pale and the scalp veins were dilated. She weighed 10 pounds (16 to 20 normal weight) and measured 56 cm. in length (69 to 71 normal). The circumference of the head was normal for her age, but that of the thorax was 35 cm. (41 to 43 normal). The blood pressure was 110/70. The cervical and axillary lymph nodes were enlarged and there was definite beading at the costochondral junctions. Harrison's groove was present. The heart and lungs were normal. The spleen was felt at the level of the umbilicus, and the liver was just palpable at the costal margin. The genitalia were normal for the patient's age. The wrist, ankle, and knee joints were enlarged, and there were bowing of the left forearm and bilateral genu valgum.

During the stay in the hospital, the blood findings were as follows: red blood cells 2.6 to 3.8 million per cu. mm.; white blood cells 5,000 to 21,000 per cu. mm.; differential white cell count 31 to 75 per cent lymphocytes; hemoglobin 40 to 84 per cent. The stained smear showed anisocytosis, polychromatophilia, and poikilocytosis on admission. The red cell fragility test was within normal limits, and

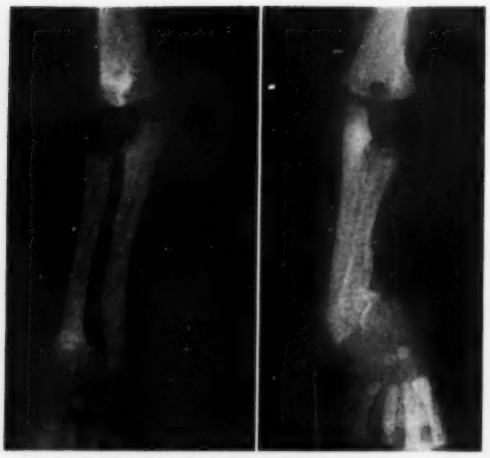

Fig. 1. Aug. 1, 1940. Osteonephropathy in an infant aged 8 months. The bones are moth-eaten; there are healed infractions at the lower ends of the radius and ulna, and in the lateral view one can see a zone of rarefaction, proximal to the zone of temporary calcification at the distal ends of the radius and ulna.

the platelet count was 59,200 to 147,000 per cu. mm. (200,000 to 400,000 normal).

The blood urea nitrogen varied from 14 to 60 mg. per 100 c.c. (8 to 15 normal); the blood sugar 50 to 57 mg. per 100 c.c. (50 to 80 normal); carbon dioxide content of the blood 21 to 57 volumes per 100 c.c. (60 to 71 normal); serum chlorides 98.6 to 125.3 mEq. (98.6 to 104.5 normal); serum calcium 8.6 to 11.0 mg. per 100 c.c. (9 to 11 normal); serum inorganic phosphorus 4.5 to 8.9 mg. per 100 c.c. (4 to 6 normal); alkaline serum phosphatase 10.4 to 61.8 Shinowara, Jones, and Rhinehart units per 100 c.c. (4 to 13.7 normal); phospholipid 10.5 mg. per 100 c.c.; serum cholesterol 160 mg. per 100 c.c. (150 to 250 normal); cholesterol esters 215 mg. per 100 c.c. (90 to 114 normal); Van den Bergh indirect 0.2 unit; glucose tolerance test 50 (fasting), 63 (1/2 hour), 48 mg. (11/4 hours) per 100 c.c.; phenolsulfonphthalein test 2.5 per cent in the first 15 minutes; blood parathyroid hormone within normal limits; adrenal intolerance test normal. The response to pitressin showed a normal antidiuretic effect, and the Kolmer and Kline serologic tests were negative.

Repeated blood cultures were negative; culture of the discharge from both ears showed *B. coli;* nasopharyngeal culture showed pneumococci type VI; the tuberculin test was negative, and a spinal fluid examination revealed normal pressure and a normal protein and cellular content.

Urinalysis showed a specific gravity from 1.005 to 1.026, moderate albuminuria, no glycosuria, rare red blood cells and occasional to abundant white cells per high power field. *B. coli* was found on culture several times. The organic acid content of the urine per day was 0.5 mEq. per kg. (0.4 to 0.8 normal), and the urinary ammonia was 0.19 mEq. per kg. per day (0.5 to 1 normal).

The ophthalmologic consultant found no abnormalities. Cystoscopy and ureteral catheterization revealed no evidence of obstruction. Six months after admission the temporal blood vessels were noted as wire-like.

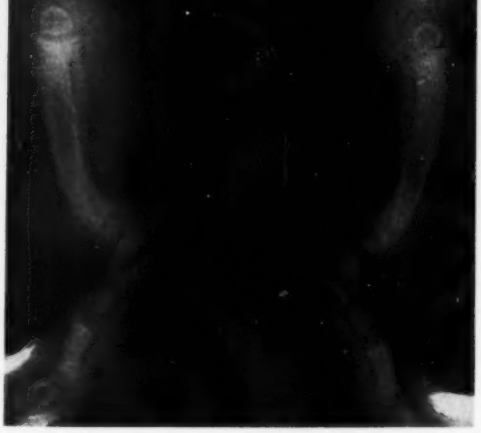

Fig. 2. Aug. 1, 1940. In the lower extremities the appearance is similar to that shown in Fig. 1. Note the zone of temporary calcification in the epiphysis of the knee. The appearance resembles that in scurvy.

During the patient's stay in the hospital, several therapeutic regimes were tried. She was given numerous blood transfusions to combat the anemia. A mixture of sodium citrate and citric acid was used to lower the *p*H of the gastrointestinal tract and dissolve calcium salts, favoring the absorption of calcium. (In the body, the citrate is converted largely to carbon dioxide and water, leaving the sodium behind to act as base. The increased alkalinity of the blood favors calcium deposition, and the presence of sodium spares the calcium from excretion as fixed base to compensate for the acidosis.) About a month after admission the child suddenly had a convulsion but responded well to aspiration, oxygen, sedation, and enemata. Lumbar puncture was done at this time. Because of the azotemia, acidosis, and hyperchloremia, she was put on a low-chloride, low-protein diet, and on this regime the serum chloride and blood urea nitrogen approached normal but she lost weight. She was put on a normal diet again and gained weight, but her hyperchloremia and azotemia recurred. For two months she was given ultraviolet irradiation for four minutes

daily, and from Aug. 19 to Sept. 5, 1940, she received 50,000 units of vitamin D daily.

In an attempt to control acidosis, 3.0 gm. of sodium bicarbonate was given daily and sodium lactate was added to the feeding formula from time to time. Bilateral otitis media developed, requiring myringotomy. Frequent episodes of pyuria and fever occurred, which were controlled with small doses of sulfonamides.

Fig. 3. Sept. 5, 1940. Considerable healing has taken place. The zones of rarefaction proximal to the zones of temporary calcification have largely disappeared. There is increased calcification of the subperiosteal osteoid bone.

Roentgen Findings: The roentgen examination of the long bones of this patient on admission revealed broadening of the shafts, flaring of the ends of the diaphyses, increased prominence of the trabeculae, and periosteal proliferation. There was a suggestion of subperiosteal hemorrhage. The metaphyses were moth-eaten and showed bony lipping. The tibiae and ulnae were bowed. Old infractions were noted at the distal ends of both radii and ulnae (Figs. 1 and 3).

On Sept. 5, 1940, after 50,000 units of vitamin D had been given daily for three weeks, definite evidence of healing appeared, indicated by filling in of the osteolytic defects (Figs. 3 and 4). On the last examination, Feb. 4, 1941, seven months after admission, continued healing at the metaphyses was evident and a ground-glass type of osteoporosis of the long bones was noted. The periphery of the epiphyseal centers showed an increase in density.

From a roentgen point of view, the presence of the fractures and the appearance of the epiphyseal centers suggested the possibility of scurvy and rickets.

Fig. 4. Sept. 5, 1940. Subperiosteal new bone is seen on the left femur, resembling the ossification of a hemorrhage such as occurs in scurvy. The zones of temporary calcification and the so-called Wimberger's rings in the epiphyses are prominent.

The roentgen examination of the skull showed a granular mottling and generalized osteoporosis. Chest films revealed healing fractures of the lower ribs. The heart and lungs were normal.

Intravenous urography was attempted on two occasions, but no contrast substance was seen. There were no calcifications in the regions of the kidneys, but the splenic artery was thought to show calcification.

The patient was re-examined on Nov. 12, 1940, almost four months after her original examination. At this time calcification in the arteries of the extremities was noticed for the first time (Fig. 5). Three months later, still further arteriosclerosis was observed radiographically.

After seven months of hospitalization, the child was discharged at the age of twenty months and a half, weighing 15 1/4 pounds. No satisfactory diagnosis had been made other than the fact that this case fell into the general group of osteonephropathies. It was felt that nothing more could be done for the child, and she was sent home with a very poor prognosis. Shortly after returning home she learned to sit alone and was able to move about on the floor.

Two months later she returned to the Outpatient Department, having gained 2 pounds in weight. She measured 25 inches in height, with a head circumference of 19 inches and a chest circumference of 16 inches. The incisors had finally erupted,

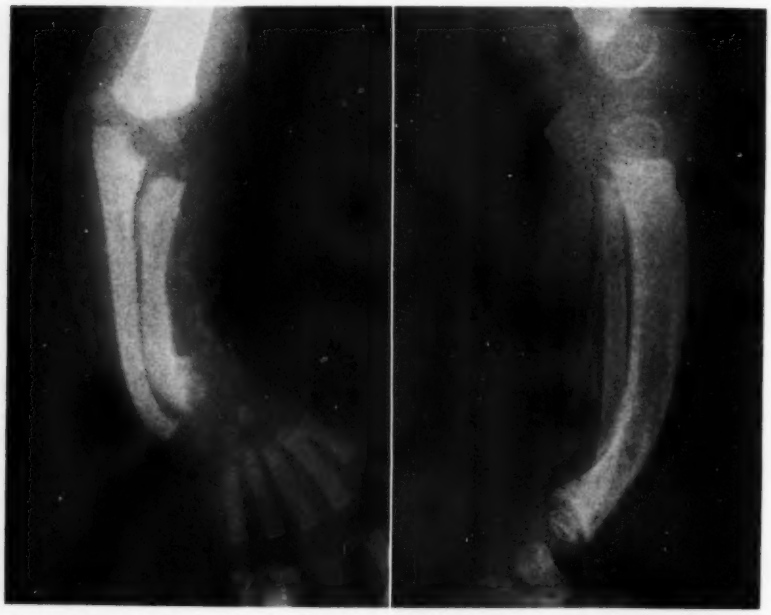

Fig. 5. Nov. 12, 1940. The healing of bones has continued. The striking change is the calcification of the larger arterial vessels in the upper and lower extremities

but in irregular order. The spleen was palpable two fingers below the costal margin, and the liver one finger below the costal margin. The hemoglobin was 55 per cent and the red cell count 3.0 million.

The patient did not return to our hospital again, but her family physician reported that she continued to have repeated episodes of acute renal infection and died in renal failure on July 25, 1945. No autopsy was obtained.

DISCUSSION

The pathologic physiology of osteonephropathy and the calcification of blood vessels and other tissues sometimes associated with this disease, as in our patient, is still undetermined. From the clinical and roentgenologic point of view, it is important to call attention to the diagnostic significance of "rickets" and vascular calcification in the presence of chronic renal disease and to the value of the roentgen examination in following the clinical course and the effects of various therapeutic agents and regimens on the bony lesions and vascular calcification. Evidence of healing of the bone lesions should not convey a false sense of security with regard to the eventual outcome in any instance.

SUMMARY

The radiologic aspects of osteonephropathy or "renal rickets" have been presented, with a report of a case with vascular calcification in infancy and a review of 14 similar cases in the literature

1. Changes may be detected in the long bones, skull, urinary tract, and soft tissues.

2. The long bone changes may be those of the ordinary rachitic type. The "woolly" type, with moth-eaten metaphyses and subperiosteal erosion, may constitute a radiologic entity.

3. The skull may show changes resembling Paget's disease or hyperparathyroidism.

4. Examination of the urinary tract may disclose polycystic kidneys, renal calculi, or nephrocalcinosis. Intravenous urography is frequently unsatisfactory because of diminished excretion of the contrast medium but may reveal hydronephrosis or hypoplasia.

5. In a small number of patients calcification of the arteries and soft tissues will develop. This can best be detected by follow-up roentgenograms.

6. The pathologic physiology of osteonephropathy is still not well understood, but at present the renal lesion must be considered a primary factor, with secondary disturbances in mineral metabolism, possibly associated with parathyroid dysfunction in most patients.

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SUMARIO

Presentación de un Caso de Osteonefropatía con Calcificación Vascular en la Infancia

Al presentar un caso de osteonefropatía, o "raquitismo renal" con calcificación vascular, en un lactante, observado a la edad de ocho meses, los AA. sumarizan además las observaciones realizadas en 14 casos recogidos de la literatura.

En los casos de esta naturaleza, pueden descubrirse radiológicamente alteraciones en los huesos largos, el cráneo, el aparato urinario y los tejidos blandos. En los huesos largos se han observado dos formas de alteración, la primera indistinguible del raquitismo ordinario, y la segunda del llamado tipo "lanoso, con engrosamiento de las epífisis, espesamiento de las trabéculas, erosiones subperiósticas y aspecto picado o "apolillado" de las metáfisis. El cráneo tal vez revele alteraciones que semejen enfermedad de Paget o hiperparatiroidismo.

El examen del aparato urinario acaso muestre policistosis de los riñones, cálculos renales o nefrocalcinosis. La urografía endovenosa resulta a menudo poco satisfactoria, debido a menor excreción del medio de contraste, pero quizás revele hidronefrosis o hipoplasia. En algunos casos, aparecerá calcificación de las arterias y los tejidos blandos.

La fisiología patológica del raquitismo renal no está esclarecida todavía. Por ahora, hay que considerar a la lesión renal como primaria, con trastornos secundarios del metabolismo mineral, enlazados posiblemente con disfunción paratiroidea en la mayor parte de los enfermos.

Protection of Irradiated Rats by Parabiosis with Adrenalectomized or Splenectomized Partners[1]

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ROBERT BINHAMMER, B.A., and JOHN C. FINERTY, Ph.D.

NUMEROUS investigations have recently been made concerning post-irradiation protection of laboratory animals (1). Miller, *et al.* (2) effectively combated the lethal effects of irradiation with large doses of Streptomycin. Salisbury and his associates (3) reported some success with exchange transfusion in six dogs. Ellinger (4) reduced lethal effects of x-radiation in mice by administration of desoxycorticosterone acetate (DOCA) after exposure. Following up a great amount of work on the protective role of the spleen, Jacobson *et al.* (5, 6) obtained an enhanced survival rate in groups of mice given supralethal dosages of radiation, by transplanting infantile spleens, spleen suspensions, or mouse embryo suspensions, into the peritoneal cavity. Cole, *et al.* (7) reported good results with single intraperitoneal injections of spleen homogenate. Recovery of irradiated animals has also been increased by bone marrow injections (8). Histopathologic study reveals that, although destruction of hematopoietic tissue was unaltered by such treatment, regeneration of these tissues was greatly enhanced.

Barnes and Furth (9) and Edwards and Sommers (10) used the technic of *pre*-irradiation parabiosis to study tissue and hematologic effects of irradiation in mice and in rats, respectively. The former workers suggested that such parabionts might survive large doses of roentgen rays if united to non-irradiated animals.

Brecher and Cronkite (11), however, showed *post*-irradiation parabiosis to be a method of substantially reducing mortality among laboratory animals exposed to lethal dosages of x-radiation. Their results were confirmed by Finerty, Binhammer, and Schneider (12) in a preliminary experiment, with even better survival rates than were obtained by the original investigators. The investigation to be reported here represents a continuation of this preliminary experiment. It is a further attempt to corroborate earlier work on post-irradiation parabiosis and to determine whether the adrenals and the spleen in a parabiont are essential for protection of its irradiated partner.

MATERIALS AND METHODS

Holtzman-Rolfsmeyer litter-mate female rats weighing from 115 to 125 gm. were used for these studies. The rats to be irradiated were placed in small cardboard boxes, 20 × 6 × 5 cm. Two boxes, each containing one rat, were centered in a 20 × 20-cm. field. In every instance, total-body irradiation was directed to the dorsal aspect of the animal. Irradiation was delivered by a GE-Maxitron with the following factors: 250 kv., 30 ma., 0.25 mm. Cu and 1.0 mm. Al filtration, h.v.l. 0.88 mm. Cu, 50 cm. F.S.D., 20 × 20-cm. field, intensity 127 r per minute.

In order to establish a dose mortality curve, 64 animals were given various doses of x-radiation ranging from 600 to 1,000 r. For the remainder of the experiment the dosage was 700 r. Ninety-one animals were exposed to 700 r and then divided into three groups: 31 were put into parabiosis with normal intact rats, 29 with adrenalectomized rats, and the remaining 31 with splenectomized partners. Adrenalectomy or splenectomy was performed at the same time that the animals were paired. Parabiosis was accomplished according to the method of Bunster and Meyer (13), under

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Nembutal anesthesia, with the irradiated animal as the left partner in every case. At the time of operation, all of the adrenalectomized rats were injected with 0.2 ml. of lipo-adrenal cortical extract (Upjohn) in an attempt to maintain the animals in good health until functional anastomosis could be established between the vascular systems of the two partners.

All of the pairs were weighed and closely inspected daily for the first thirty days. After this observation period, the pairs were separated (under ether anesthesia). Metal skin clips were used to close the wounds. A weekly record of body weights was kept during an additional thirty-day period of observation. With the termination of the experiment at sixty days, 11 pairs in the irradiated-normal group, 10 pairs in the irradiated-splenectomized group, and the 13 irradiated partners of the adrenalectomized animals that were still alive were set aside for a study of the long-term effects, direct and perhaps indirect, of the irradiation on both rats. The remainder of those surviving were sacrificed for histologic studies.

At the time of autopsy, thymus, thyroid, uterus, ovaries, and adrenals were removed and weighed on a Roller-Smith torsion balance. In addition to the thyroid, ovaries, and adrenals, the pituitary, specimens of bone marrow taken from the femur, and the spleen were fixed in Zenker-formol solution for histologic study.

Twenty-three normal-normal pairs (non-irradiated) served as controls for parabiosis. They were treated just as were the experimental pairs, with the exception that only 5 pairs were separated at thirty days to be observed for the additional thirty-day period.

TABLE I: DOSE-MORTALITY CURVE FOR SINGLE INTACT FEMALE RATS

Single Intact Controls	No. of Rats	Survival at 30 Days after Irradiation
Irradiated, 600 r	10	8 (80%)
Irradiated, 700 r	24	1 (4%)*
Irradiated, 800 r	10	0
Irradiated, 900 r	10	0
Irradiated, 1,000 r	10	0

* Sole survivor died on the seventy-fifth post-irradiation day.

TABLE II: EFFECTS OF PARABIOSIS AND ADRENALECTOMY OR SPLENECTOMY ON SURVIVAL OF X-IRRADIATED FEMALE RATS

Treatment		No. of Pairs	Survival at 30 Days	Survival at 30 Days after Separation	
Left Partner	Right Partner			Left Partner	Right Partner
Normal	Normal	23	16 (70%)	16	16
Irradiated, 700 r	Normal	31	25 (81%)	24	24
Irradiated, 700 r	Adrenalectomized	29	17 (59%)	13	3*
Irradiated, 700 r	Splenectomized	31	21 (68%)	21	20

* All had hypertrophied accessory adrenal tissue.

RESULTS

As shown in Table I, 80 per cent of single, intact control animals survived a dose of 600 r. Increasing the dosage by 100 r reduced the survival to 4 per cent. In other words, 700 r was, with our method, an LD 96 dose at thirty days. All animals irradiated with more than 700 r failed to survive the thirty-day post-irradiation period; most had succumbed after only eight days.

Table II presents results obtained with the parabionts. Of the 23 original normal-normal pairs, 16, or 70 per cent, survived. Parabiosis intoxication caused the death of 3 pairs in this group. Other deaths were due to such factors as incompatibility, poor administration of anesthetic during repair, and self-separation by one pair.

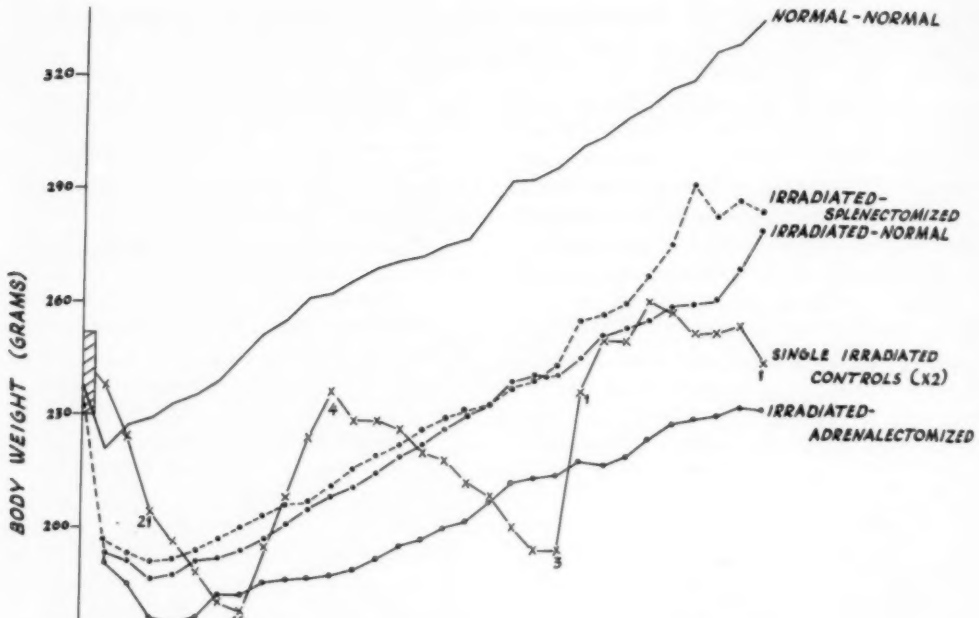

Fig. 1. Average daily body weights of irradiated single rats and various combinations of parabiotic rats during the thirty days following exposure to 700 r. The blocked off area at "day zero" represents the range of weight at time of irradiation. Weights of single irradiated rats were doubled to fit on the same graph as the pairs. Fluctuation of the curve of unpaired rats is a result of death of the more emaciated animals, causing artificial increases in the average. Numbers under that line represent the number of animals surviving.

Of the original 91 parabionts of which one partner had suffered x-radiation damage, 63 survived the first thirty days, the average combined survival rate being 69.3 per cent as compared with the 4 per cent for 24 single rats receiving the same dosage of irradiation.

Consideration of the groups individually, as shown in Table II, indicates that 25 of 31 irradiated-normal pairs, or 81 per cent, survived the thirty-day observation period. After separation, all of the animals lived an additional thirty days or more. Survival of the irradiated-adrenalectomized pairs at thirty days was 59 per cent. When the 17 surviving pairs were separated, all but 3 of the adrenalectomized partners died of adrenal insufficiency within a few days, whereas 13 of the irradiated partners lived more than an additional thirty days. The irradiated-splenectomized group showed a survival rate of 68 per cent at the end of thirty days. When separated, all but 1 animal lived more than the additional thirty-day period.

Figure 1 indicates graphically the body weights of the pairs. The blocked-off area at the left represents the range of weight of the pairs at the time of irradiation. Weights of the single control animals were doubled in order to place them on the same graph. Parabiosis accounts for some of the weight loss during the first day after operation, since the pairs usually fail to eat until the second day of union. However, additional weight loss is caused by irradiation during the first four days. It can be seen that weight loss in the three experimental parabiotic groups ceased by the fourth day, *i.e.*, approximately the time of functional vascular anastomosis between partners (Finerty,

TABLE III: PERSISTENT EFFECTS OF POST-IRRADIATION PARABIOSIS ON BODY AND ORGAN WEIGHTS*

Treatment*	No. of Animals	Relative Organ Weights (mg./100 gm.) ± Standard Error					
		Body Weight (gm.)	Adrenals (mg.)	Thymus (mg.)	Ovaries (mg.)	Uterus (mg.)	Thyroid (mg.)
Normal-normal							
Right partners	4	223 ±7.2	28.4 ±2.9	145 ±9.8	32.1 ±2.1	233 ±13	5.7 ±.3
Left partners	4	226 ±1.7	27.7 ±2.1	144 ±11.5	34.3 ±2.5	191 ±25	6.5 ±.3
Irradiated-normal							
Right partners	12	203 ±6.8	27.4 ±1.1	125 ±14	28.4 ±1.7	212 ±17	6.0 ±.3
Left partners	13	184 ±4.4	25.7 ±1.1	96 ±14	17.6 ±1.4	129 ±14	6.6 ±.4
Irradiated-splenectomized							
Right partners	11	197 ±4.6	31.9 ±1.6	129 ±7.8	34.2 ±2.2	237 ±26	6.6 ±.6
Left partners	12	175 ±2.7	25.9 ±0.6	86 ±7.2	19.6 ±1.2	112 ±5.5	6.3 ±.2

* All rats were paired for thirty days, surgically separated, and observed an additional thirty days prior to autopsy. Irradiated rats were exposed to 700 r within two to three hours before pairing.

14). On the other hand, loss of weight was seen in the single controls until a large number had succumbed. At that time an artificial rise in weight occurred, followed again by a slow decline until only one animal remained.

Organ weights obtained thirty days after separation of the pairs are presented in Table III. In each group there is a statistically significant decrease in body weight and in the weight of ovaries and uterus of the partners which had been irradiated sixty days before. No significant difference in the weight of the thyroid or adrenal glands was observed. The splenectomized rats showed an increase in adrenal weight which is difficult to explain. Subsequent observations of single splenectomized rats failed to substantiate such an effect.

DISCUSSION

Protection from irradiation mortality in this experiment is similar to that previously described by Brecher and Cronkite (11) and Finerty, Binhammer, and Schneider (12).

Difference in the survival rates of post-irradiated parabionts from those of single irradiated controls has been found to be highly significant statistically. The difference in survival rates between the irradiated-normal and the irradiated-adrenalectomized animals approaches statistical significance. However, if one takes into consideration the fact that the added stress of joining adrenalectomized animals with normal partners results in a greater percentage of mortality, the difference between the groups with respect to irradiation would be negligible.

The irradiated-adrenalectomized pairs provide an interesting study. Here we find a case of mutual protection. The irradiated partner was successful in combating adrenal insufficiency in the adrenalectomized animal, while the latter, in turn, protected its partner from radiation mortality. The protection against adrenal insufficiency was on a temporary basis, as is evidenced by the death of all but 3 of those animals after separation from their partners. In the 3 surviving animals, autopsy showed the presence of hypertrophied accessory adrenal tissue. Protection of the irradiated animal by the adrenalectomized partner was of a much more permanent nature. Only 4 of the irradiated members of these pairs failed to survive the thirty-day period after separation.

One of the striking aspects in this experi-

Fig. 2. Parabiotic rats at thirty days following surgical union; the left partner (at right of picture) had been exposed to 700 r within two to three hours prior to the parabiosis operation. Note smaller size and delayed regrowth of hair over shaved areas of the irradiated partner.

ment is the appearance of the pairs thirty days after exposure of one member to x-radiation. As depicted by Figure 2, the irradiated partner is the smaller of the two animals and, even after thirty days, has failed to regrow hair shaved at the time of pairing. No sign of epilation in the non-irradiated rat was ever seen by the authors, in contrast to the report of a pre-irradiation parabiosis experiment by Van Dyke and Huff (15). Hair on the irradiated animal is much sparser than that of its partner. With the exception of the irradiated partners of the adrenalectomized animals, which had more difficulty in growing hair, there was no essential difference in the amount of epilation among the various groups. Increased adrenal cortical function in the irradiated rat which compensates for adrenalectomy of its partner probably explains the added difficulty in hair growth of these rats (Ralli and Graef, 16; Copp and Finerty, 17).

The occurrence of parabiosis intoxication is most interesting. It generally has been found that 25 to 30 per cent of litter-mate pairs are affected by this syndrome, for which the definite etiology is unknown (Gumbreck, 18; Chute and Sommers, 19). Non-litter-mate pairs have an even greater incidence of intoxication (Finerty and Panos, 20). In this experiment, careful observation ascribes to parabiosis intoxication a mere 7.7 per cent mortality among 91 pairs. This, in our experience, is a considerable reduction in the number of deaths regularly to be expected among parabionts. Because of this, the survival of the irradiated-normal pairs actually was better than has been found for normal-normal pairs. Since pathologically the syndrome resembles an anaphylactoid reaction, it is possible that inhibition of antibody formation in the irradiated rat is responsible for the decrease in intoxication mortality (Hektoen, 21; Jacobson *et al.*, 22).

The mechanism of protection from the lethal effects of x-radiation is of primary interest in a study of this type. In view of Jacobson's extensive work on the protective influence of the spleen against radiation effects, followed by Cole's experiments with spleen homogenate, one might have expected different results in the irradiated-splenectomized group as compared to the other groups. It would seem from this study that there are other factors at work as important as the spleen in affording protection from the effects of irradiation. Massive blood transfusion may be one of those factors, since it has been calculated that approximately 0.66 per cent of the total blood volume passes between partners every minute (Huff, Trautman, and Van Dyke, 23). Conflicting opinions upon the effects of blood transfusion in irradiated animals have come from Swisher and Furth (24) and from Allen *et al.* (25). The former investigators ameliorated symptoms in dogs given 550 r by removal and subsequent replacement of 250 c.c. of whole blood. Allen *et al.* noted no improvement in the survival rate or survival time of a large number of their dogs given three transfusions weekly after 450 r total body irradiation. However, relative blood volumes given in both these experiments represent only a fraction of those passing between parabiotic animals.

In the case of one pair of the irradiated-normal group, the normal animal died of anesthesia during a repair early in the experiment. The irradiated animal was saved and survived in spite of only seven days of union. Allowing three to four days for vascular anastomosis, this rat survived after functional parabiosis of three to four days. It would seem, then, that the protective effect may already have been exerted by that time.

CONCLUSION AND SUMMARY

The protective effect of parabiosis upon irradiated rats was shown in this experiment. Three groups of animals were described in which one member of a littermate pair had previously received an LD 96 30-day dose of x-radiation. One group of 31 pairs consisted of irradiated-normal parabionts in which survival at thirty days was shown to be 81 per cent. A second group of irradiated-adrenalectomized pairs showed a survival of 59 per cent after the same length of time. Irradiated-splenectomized pairs made up a third group, with a survival rate of 68 per cent. Separation of all of the pairs was done thirty days after exposure to x-rays and all but 5 irradiated animals survived an additional thirty days.

It is concluded that post-irradiation parabiosis permanently protects a great majority of irradiated rats from the lethal effects of irradiation. Since neither adrenalectomy nor splenectomy of the non-irradiated partner significantly changed the degree of protection, it is further concluded that the presence of neither the adrenals nor the spleen is necessary in the non-irradiated partner for permanent protection from irradiation by parabiosis.

NOTE: The authors are indebted to Dr. J. Allen Scott, University of Texas Medical Branch, for advice and assistance with statistical analysis of the data.

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SUMARIO

Protección de las Ratas Irradiadas por Medio de la Parabiosis con Compañeras Suprarrenalectomizadas o Esplenectomizadas

Este experimento fué emprendido para demostrar el efecto de la parabiosis sobre las ratas irradiadas. Noventa y un animales fueron expuestos a irradiación roentgen de todo el cuerpo a una dosis de 700 r, que según se observó, producía una mortalidad de 96 por ciento en treinta días en un grupo de testigos intactos aislados. A 31 de los animales irradiados se les puso en parabiosis con compañeros intactos normales de la misma camada, y en este grupo la sobrevivencia a los treinta días resultó ser de 81 por ciento. En otro grupo, compuesto de 29 pares en los que el parabionte no irradiado había sido suprarrenalectomizado, el coeficiente de sobrevivencia fué de 59 por ciento al cabo de un período de tiempo semejante, y en otro grupo, el tercero, en que el animal irradiado fué unido a un compañero esplenectomizado, la sobrevivencia llegó a 68 por ciento. La separación de todas las parejas se ejecutó a los treinta días de la exposición a los rayos X y todos los animales irradiados, aparte de 5, sobrevivieron otros treinta días.

Dedúcese que la parabiosis postirradiatoria protege permanentemente a una gran mayoría de las ratas irradiadas contra los efectos letales de la irradiación. Visto que ni la suprarrenalectomía ni la esplenectomía del compañero no irradiado modificaron mayor cosa la magnitud de la protección, dedúcese además que no se necesitan ni la presencia de las suprarrenales ni la del bazo en el compañero no irradiado para la protección permanente con la parabiosis.

Cholangiography with a Viscous, Water-Soluble Contrast Medium

(Diodrast in Methylcellulose)[1]

GEORGE JACOBSON, M.D., and KENNETH A. HEITMANN, M.D.

NUMEROUS ATTEMPTS have been made to develop a water-soluble, viscous contrast medium suitable for bronchography, cholangiography, and similar examinations, without the disadvantages of oily substances such as Lipiodol. Diodrast (and other iodinated organic compounds) dissolved in an aqueous solution of methylcellulose has been investigated rather extensively as a contrast medium for bronchography (3, 7, 10). Recent reports and our own experience would indicate that it is not entirely satisfactory for this purpose in that a greater degree of local anesthesia is required than with Lipiodol, absorption is so rapid that it is difficult to obtain adequate roentgenograms, and there is the possibility that granulomatous lesions may be produced in the lung (11). Diodrast in methylcellulose, however, we have found to be an ideal contrast medium for cholangiography. Of the various concentrations of the two substances which were tried, 35 per cent Diodrast and 1 per cent methylcellulose produced a contrast medium of optimum density and viscosity. No reactions attributable to either Diodrast or methylcellulose have been observed in approximately 100 cholangiographies at the Los Angeles County Hospital during the past year.

When given parenterally, Diodrast may give rise to so-called "allergic" reactions of varying degrees. When the Diodrast-methylcellulose mixture is injected into an unobstructed common bile duct, however, it passes into the duodenum with sufficient rapidity that little or none of the Diodrast is absorbed from the biliary system. When the mixture is injected into an obstructed common duct and the T tube clamped off, the Diodrast is absorbed slowly over a period of several hours. Usually the T tube is not clamped and the contrast medium drains off rather rapidly. We do not feel that it is necessary to test for sensitivity to Diodrast before making the injection into the common bile duct, since ordinarily none of the medium is absorbed and no reactions occurred in any of our patients. Furthermore, there is no convincing correlation between tests for sensitivity and reactions to the drug (2, 4, 8, 12).

To date, we have used only methylcellulose to increase viscosity. Sodium carboxymethylcellulose may be substituted, however, with some advantage, since its properties are similar to those of methylcellulose, and in addition it can be heat-sterilized (9).

Methylcellulose has been used, among other things, as a blood substitute. When administered intravenously, it accumulates in the reticuloendothelial system, from which it is removed slowly. The function of this system may be interfered with when the deposits are extensive. Methylcellulose is excreted by the kidneys and possibly to some degree by the intestinal mucosa (5, 6). It is entirely non-toxic when given by mouth and has been used in the food industry (1, 9). Since none of the patients in whom cholangiography was performed with this material has died, there has been no opportunity to determine whether there were residual deposits of methylcellulose in the liver parenchyma or biliary radicles. A number of patients, however, have undergone a second operation because of common duct calculi or obstruction, and in none of these, even

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Figs. 1 and 2. Normal cholangiograms. Fig. 2 shows retrograde filling of cystic duct and gallbladder.

Fig. 3. Cholangiogram showing slight dilatation of common bile duct and intrahepatic ducts. Note filling of ampulla of Vater and pancreatic duct.

where there had been some leakage of the contrast medium about the T tube, was there any evidence of tissue reaction to the material. There would appear to be little or no danger, therefore, of any harmful effects arising from the use of methylcellulose in cholangiography.

The advantages of 35 per cent Diodrast in 1 per cent methylcellulose as a contrast medium for cholangiography may be summarized as follows:

1. It forms a continuous column, being miscible with bile, and there is none of the disturbing globule formation seen so frequently with oily media.

2. The density is such as to permit adequate fluoroscopic visualization and the obtaining of excellent roentgenograms, yet not so great that small radiolucent calculi contained in a large dilated common bile duct are obscured.

3. Because of its viscosity, the medium is retained in the unobstructed common duct long enough for fluoroscopic examination and spot-film and conventional radiog-

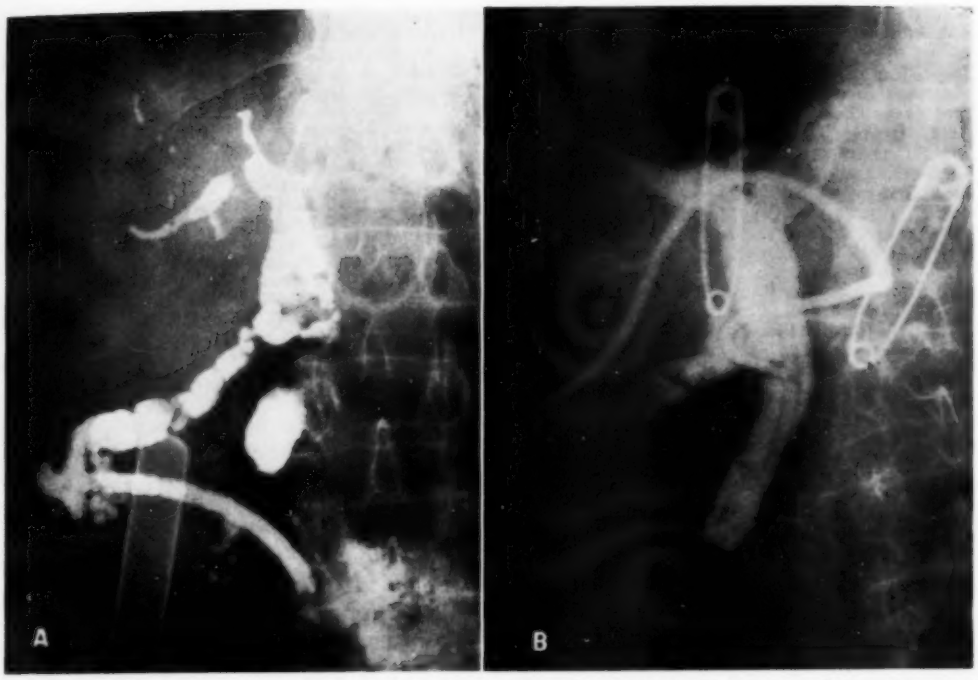

Fig. 4. A. Cholangiogram obtained with Lipiodol. Note marked globule formation. B. Cholangiogram of same patient three months later, obtained with Diodrast in methylcellulose. Note multiple common duct and hepatic duct calculi.

raphy. The material also possesses some of the advantages of a non-viscous aqueous medium in that it will penetrate small openings such as a partially obstructed cystic duct and can be injected through a fairly small bore needle.

4. Medium which may leak about the insertion of the T tube into the common duct is absorbed rapidly and does not give rise to permanent obscuring densities.

5. Since it is water-soluble and non-oily, the contrast medium is removed easily from the table-top, hands, and clothing.

6. No reactions attributable either to the Diodrast or methylcellulose have been observed.

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Fig. 5. Cholangiogram showing dilated common duct containing multiple calculi.

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SUMARIO

La Colangiografía con un Medio Hidrosoluble, Viscoso, de Contraste, Diodrasto en Metilcelulosa

El Diodrasto (35 por ciento) en metilcelulosa (1 por ciento) resultó ser un medio de contraste de lo más satisfactorio para la colangiografía. Es miscible con la bilis y forma una columna continua sin la perturbadora formación de glóbulos, observada tan frecuentemente con los medios oleosos. Debido a su viscosidad, se retiene el medio en el colédoco despejado el tiempo suficiente para el examen roentgenoscópico y la obtención de radiografías. La densidad es adecuada para dichos fines, y sin embargo, no es tal que eclipse los pequeños cálculos radiolucientes en el colédoco dilatado.

En unos 100 estudios colangiográficos, no se observaron reacciones imputables al Diodrasto o a la metilcelulosa.

Cholecystography

A Critical Review[1]

ROBERT SHAPIRO, M.D.

ORAL CHOLECYSTOGRAPHY implies passage of the contrast medium through the pylorus into the small bowel, where it is absorbed by the portal circulation and carried to the liver. In the presence of adequate hepatic function, bile is secreted by the liver cells and flows down the hepatic ducts. In the fasting state, the bile is unable to enter the duodenum because of the normal tonicity of the choledochal sphincter mechanism. When the intracholedochal pressure reaches a height of 50 to 70 mm. of water, the bile is forced up into the cystic duct and thence into the gallbladder, where it is concentrated and stored (13, 18).

In the fasting state, the gallbladder is not stimulated to contract and may not empty itself for many days (10, 22). Following the ingestion of fat, however, the hormone cholecystokinin is liberated from the intestinal mucosa and causes contraction of the gallbladder (19). Simultaneous relaxation of the choledochal sphincter results in expulsion of the concentrated bile into the duodenum. The action of cholecystokinin is directly on the muscularis of the gallbladder. This has been demonstrated by numerous investigators who sectioned the vagus and splanchnic nerves without influencing gallbladder contractility (1).

Hydrochloric acid has a similar though less marked effect on gallbladder contraction. Thus, in individuals with hyperchlorhydria (*e.g.*, duodenal ulcer), the gallbladder may contract vigorously and empty itself early. If, therefore, films are made at the conventional time (twelve to sixteen hours after the contrast medium has been ingested) an erroneous diagnosis of a non-functioning gallbladder may be made.

The effect of achlorhydria, on the other hand, is not nearly so well understood, and the experimental and clinical data pertaining to this matter appear to be contradictory. Thus, Morgan and his co-workers demonstrated that gallbladder function in the dog is not impaired by complete achylia (20), a finding which was corroborated by the clinical studies of Davis and Talley (15). On the other hand, in a study of 11 patients with achlorhydria, Hines obtained normal gallbladder visualization in none (17). Ivy explains this failure of visualization on the basis of atonicity of the duodenum sufficient to decrease intracholedochal pressure so that the bile, impregnated with the contrast medium, freely runs down the extrahepatic ducts into the duodenum without ever entering the gallbladder (18, 19). The apparent discrepancy in these reports is not particularly resolved by Boyden and Layne's study of 48 patients with pernicious anemia (9). In the latter group, 15 out of 23 males had normal gallbladder visualization following the intravenous injection of sodium tetraiodophenolphthalein. However, in 12 out of 25 females the gallbladder was not visualized. It is difficult to relate these findings to the absence of free hydrochloric acid. Perhaps the high incidence of non-visualization in this group is related to the increased pigment formation in pernicious anemia, with a resultant increase in the incidence of cholelithiasis. The larger number of poorly visualized gallbladders in the females may possibly be due to the fact that many of these patients had undergone multiple pregnancies and to the normally higher incidence of gallstones in older women.

Drugs may considerably alter the normal motor response of the gallbladder. Thus,

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morphine sulfate and its derivatives produce profound spasm of the choledochal sphincter, while amyl nitrite, atropine, and other nitrites evoke relaxation of the sphincter mechanism (18). Magnesium sulfate, epinephrine, pituitrin, acetyl choline, eserine, and histamine may also excite gallbladder contraction with simultaneous sphincteric relaxation (2, 4, 7). The effect of the latter drugs, however, is not constant. Sodium hydroxide and sodium bicarbonate, on the other hand, produce synchronous relaxation of the gallbladder, together with closure of the choledochal sphincter (11).

Curl (14) and Brewer (10) have shown that in normal subjects on a prolonged fat-free diet the gallbladder does not empty satisfactorily and becomes filled with thick, concentrated bile. Consequently, when cholecystography is attempted, the fresh bile, laden with the contrast material, is unable to enter the gallbladder, thus resulting in poor or non-visualization. When emptying is obtained in these patients by a fatty meal, re-examination demonstrates normal concentration of the medium.

The literature is replete with misinformation concerning the response of the normal gallbladder to a fatty meal. In Boyden's original work, the *average* first phase response of the gallbladder to a fatty meal occurred within forty minutes (3, 6, 8). The response in any given individual, however, may vary considerably from the average and still be perfectly normal. Boyden used tetraiodophenolphthalein, which does not interfere with normal gallbladder contractility. Most of the recent studies have been done with Priodax, which definitely affects contractility (12). This is particularly striking if one studies the effect of a fatty meal in normal patients first with Priodax and then with Telepaque or Teridax, which do not depress gallbladder contractility.

Normal pregnancy is known to interfere with gallbladder emptying. Boyden noted that the mean rate of emptying was markedly retarded during the last two trimesters. This is probably related to the profound hormonal changes which take place in the pregnant state. A large proportion of apparently normal women examined at term had elevated cholesterol and low bile salt levels in the gallbladder, comparable to those in cholecystitis and cholelithiasis (16).

In general, the purpose of the fatty meal in clinical cholecystography is not to study gallbladder contractility but rather to increase the chance of demonstrating small stones in a lesser volume. This is analogous to the demonstration of a gastric polyp in a stomach containing a small amount of barium as contrasted to masking of the polyp in the same stomach distended with barium. It is important to avoid drawing erroneous pathological-anatomical conclusions from variations in normal physiology. Consequently, radiologists should refrain from diagnosing gallbladder disease, in the face of good concentration of the medium and no stones, merely on the basis of a delayed response to a fatty meal.

Non-visualization or poor visualization, then, may be due to a variety of factors, many of which are extracholecystic in origin:

1. Failure of the patient to ingest or retain the contrast substance
2. Delayed gastric emptying
   (*a*) Pyloroduodenal obstruction
   (*b*) Psychogenic factors resulting in prolonged pylorospasm
3. Failure of absorption of the medium
   (*a*) Diarrhea
   (*b*) Pancreatic disease
   (*c*) Primary disease of the small intestine
4. Impairment of hepatic function
5. Too rapid emptying of the gallbladder, *e.g.*, hyperchlorhydria
6. Physiological stasis
7. Drug effect
8. Previous cholecystectomy
9. Cystic duct stone
10. Severe disease of the gallbladder mucosa preventing adequate concentration of the medium

11. Lactation. Olsson has demonstrated that non-visualization may occur in lactating mothers due to excretion of tetraiodophenolphthalein in the milk (21)

SUMMARY

The physiology of the normal gallbladder is reviewed, with a discussion of the various factors which may result in poor or non-visualization.

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SUMARIO

La Coleciostografía: Estudio Analitico

Repásase aquí la fisiología de la vesícula biliar normal, discutiendo los varios factores que dan por resultado mala visualización o falta de ésta. Muchos de éstos son de origen extracolecístico, comprendiendo: incapacidad del enfermo para ingerir o retener el medio de contraste; retardo en el vaciamiento del estómago debido a oclusión piloroduodenal o pílorcspasmo prolongado; insuficiente absorción del medio por haber diarrea, afección pancreática o enfermedad primaria del intestino delgado; insuficiencia hepática; vaciamiento demasiado rápido de la vesícula biliar (como en caso de hipoclorhidria); éstasis fisiológico; efectos de ciertas drogas; colecistectomía anterior, cálculo del conducto cístico; afección grave de la mucosa de la vesícula biliar que impide la concentración adecuada del medio; lactancia.

Urethral Calculus: Its Roentgen Evaluation[1]

PAUL S. FRIEDMAN, M.D., LEON SOLIS-COHEN, M.D., and SAMUEL M. JOFFE, M.D.
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THE CASE OF urethral calculus to be reported here is of interest because of the absence of symptoms in spite of the large size of the stone and because it demonstrates the value of urethrography for localization and evaluation.

CASE REPORT

A 53-year-old white male was referred for roentgen examination of the perineal region because of his accidental palpation of a perineal mass during bathing. His past history was entirely non-contributory, revealing no urinary tract abnormality or infection.

Physical examination disclosed the presence of a fixed, stony hard perineal mass, immediately posterior to the scrotum; its precise dimensions could not be determined. Otherwise the physical findings were normal. Digital rectal examination demonstrated a prostate of normal size and consistency. Except for the presence of small numbers of polymorphonuclear leukocytes in the urine, laboratory studies were also normal.

Radiographic examination of the pelvic region revealed a large, oval, lamellated calculus in the subpubic region (Fig. 1). Study in the lateral and oblique planes confirmed its anterior and subpubic location. It was believed to be a calculus located in a urethral diverticulum. Urethrography was recommended, both to confirm the location of the stone and to determine whether or not urethral stricture was present.

Urethrography was performed on Feb. 7, 1951, under fluoroscopic guidance. Rayopake, injected intra-urethrally, through an attached Brodny clamp, passed through the urethra adjacent to the calculus into the bladder. Film study confirmed its apposition to the membranous urethra. No stricture was demonstrable. There was minimal elongation of the prostatic urethra (Figs. 2 and 3).

Immediate operation was recommended, but was postponed by the patient. On March 14, 1951, he reported with perineal induration and inflammation, with fluctuation superficial to the calculus. He was hospitalized on March 16, and on March 17 spontaneous superficial drainage occurred. Under spinal anesthesia, the area of spontaneous perforation was enlarged and explored by Dr. James Lehman. The calculus could not be palpated and it was believed to have passed spontaneously. Iodoform packing was inserted.

Postoperative roentgen examination, however, again revealed the calculus. On March 27, under spinal anesthesia, with an intra-urethral catheter present, a transverse perineal incision was made. The transverse perinei muscles were divided, and the calculus was palpated in the membranous urethra just distal to the prostate. A longitudinal incision was made in the urethra and the calculus removed. The urethra was sutured around the indwelling catheter, an iodoform pack drain was inserted, and several interrupted silk sutures were introduced in the skin.

Fig. 1. Plain film showing large oval calculus in the subpubic region. Note also associated prostatic calculi.

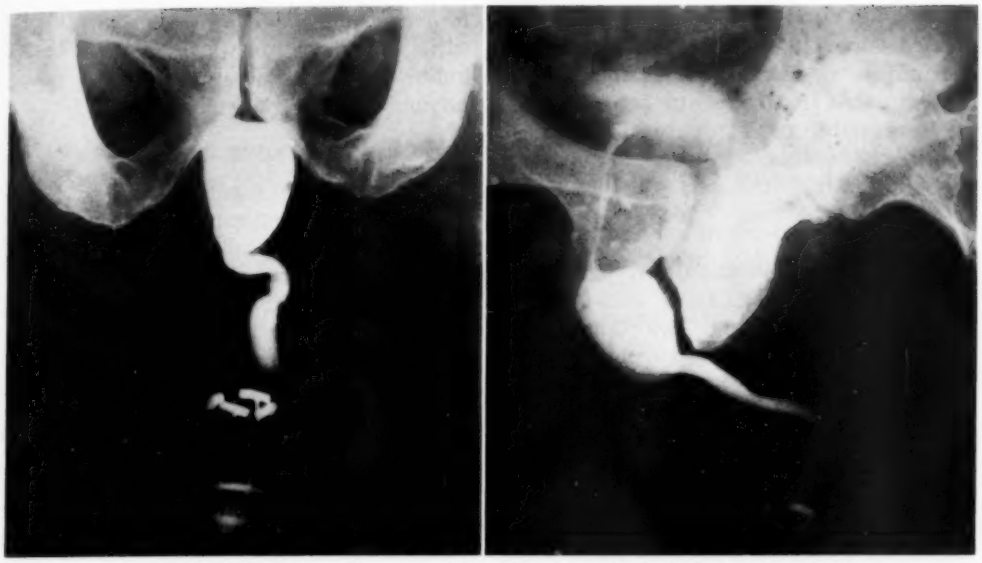
The calculus was 4.2 cm. long, 3.0 cm. wide, and 2.5 cm. in anteroposterior diameter (Fig. 4).

Penicillin was given preoperatively and postoperatively. The postoperative course was uneventful, and voiding occurred spontaneously and without complaint. The patient was discharged April 10, 1951. By May 24 the perineal wound was healed and there was no longer any complaint of urinary symptoms.

DISCUSSION

Urethral calculi, while not rare, are uncommon clinical entities. Le Comte found urethral calculi 7 times in a series of 2,900 urologic cases. In 41 per cent of cases they are in the posterior urethra, and in 59 per cent in the anterior urethra. The latter group includes 19 per cent in the bulbous segment, 14 per cent in the scrotal segment, 15 per cent in the penile urethra, and 11 per cent in the fossa navicularis.

[1] Accepted for publication in January 1953.



Figs. 2 and 3. Urethrograms (anteroposterior and left oblique) showing the calculus in apposition to the membranous urethra. No stricture demonstrable. Minimal elongation of prostatic urethra.

Urethral calculi are of two major types, primary and secondary. The former originate within the urethra; the latter migrate to the urethra from elsewhere in the urinary tract.

The primary calculi are usually a result of urinary stagnation and infection in poorly draining intra-urethral and para-urethral cavities. Such cavities may result from prostatic and peri-urethral abscesses, postgonorrheal urethral glandular infection, congenital or acquired diverticula, and mucosal ulcerations. An intra-urethral foreign body may also serve as a nucleus for the formation of primary stones. Stricture has not proved to be a common etiologic factor. Primary calculi often occur as single stones unless they develop in a diverticulum, when they are likely to be multiple. They usually consist of calcium phosphate.

Secondary calculi migrate to the urethra from the kidneys or bladder, and are ten times more frequent in males. They are almost always single. They are usually much smaller than the primary variety and their incidence is almost eleven times as high. They usually contain a nucleus of uric acid and calcium oxalate.

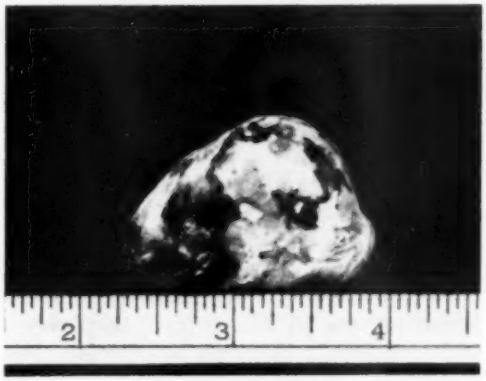


Fig. 4. Urethral calculus after removal.

Primary urethral calculi are often asymptomatic for a long period. The secondary variety frequently produce sudden partial or complete urethral obstruction, requiring relief. In the presence of partial obstruction, there may be dribbling or delay in starting voluntary bladder evacuation.

It is frequently possible to palpate the calculus.

Radiologic examination is definitive in establishing the diagnosis. The calculi almost invariably have adequate calcium

content for visualization on the plain film. They are located in the subpubic region in the midline or close to it. They may be differentiated from prostatic calculi, which are suprapubic or retropubic in location, multiple in number, 2 to 4 mm. in diameter, and bilaterally distributed. Pelvic vascular phleboliths may readily be distinguished.

For further evaluation, urethrography is essential. This is most satisfactorily done by intra-urethral injection of an opaque medium through an attached Brodny clamp, under fluoroscopic visualization. During injection, fluorographic (spot-film) studies may be made. Injection is continued until the opaque medium enters the bladder. Following this, anteroposterior and oblique films of the urethra and base of the bladder are obtained. Injection is maintained during film exposure. We have found the most satisfactory medium to be a mildly viscid iodine-containing substance, such as Medopaque.[2]

SUMMARY

A case has been reported of an extremely large primary urethral calculus which was apparently asymptomatic for many years. It was first evident clinically on accidental manual palpation and was demonstrated by roentgen study. Further evaluation and localization were obtained by urethrography. In spite of roentgen localization, the calculus was not found at the first surgical exploration. At a second operation with an intra-urethral catheter present it was successfully removed.

1422 Chestnut St.
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[2] Manufactured by Bell-Craig, Inc.

SUMARIO

Cálculo Uretral: Su Justipreciación Roentgenológica

Descríbese un caso de cálculo uretral primario, que resulta interesante, debido al tamaño (4.2 × 3.0 × 2.5 cm.), a no haber producido, durante un período prolongado, síntomas, y por fin a su descubrimiento y justipreciación por medio de la uretrografía.

El cálculo fué descubierto por el enfermo en una palpación fortuita y observado en una radiografía corriente. Fué localizado ulteriormente por la uretrografía con Rayopaco inyectado bajo visualización roentgenoscópica a través de una pinza de Brodny conectada.

A pesar de la localización roentgenológica, no se descubrió el cálculo en la primera exploración quirúrgica. Fué observado de nuevo radiográficamente y extraído con éxito en la segunda operación con un catéter intrauretral introducido.

X-Ray Studies of the Ileocecal Valve in Ileocecal Tuberculosis[1]

J. GERSHON-COHEN, M.D., and VICTOR KREMENS, M.D.

DURING THE past twenty-five years, the double-contrast examination has been a routine procedure in the diagnosis of ileocecal tuberculosis at Eagleville Sanatorium (4, 5). The progress meal and, rarely, enteroclysis (6, 7) are used as supplementary examinations if the double contrast studies fail to disclose intestinal lesions suggested by the clinical picture. Frequently these extra studies are not indicated. Even more often they fail to yield additional positive information.

The ileocecal valve is a focal point of particular interest in ileocecal tuberculosis, since most of the lesions are centered about this structure (1). The double-contrast enema always furnishes information relative to the cecal side of the valve. Since reflux filling of the terminal ileum is encountered much less frequently in ileocecal tuberculosis than under normal conditions (3), due to spasm and irritability of the diseased structures, study of the function and pathology of the valve itself can contribute much toward an accurate diagnosis even though barium and air both fail to reach the ileum during the course of the roentgen examination.

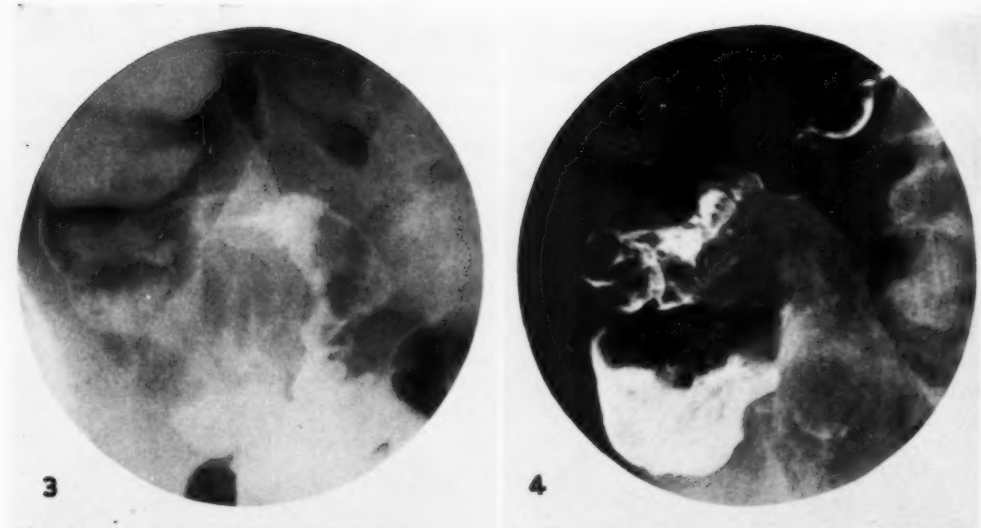
Fig. 1. The upper lip of the ileocecal valve is shorter than the lower (which is the reverse of normal), and the edges and ileal surfaces of both lips are irregular. This patient had moderately advanced exudative cavernous tuberculosis in the right upper lobe. An appendectomy was done forty-eight hours after the x-ray examination, and minimal appendiceal and ileocecal tuberculosis was found.

Fig. 2. The thick irregularly contoured lips of the closed ileocecal valve are due to tuberculosis, which is also responsible for the irregular shortening and contraction of the cecum. The patient died of a pulmonary hemorrhage twenty-seven days after this roentgenogram was made. Moderately advanced ileocecal tuberculosis was found, with diffuse involvement of the cecum, especially around the ileocecal valve. The terminal ileum was practically free of disease.

THE TUBERCULOUS ILEOCECAL VALVE

So-called "incompetency" of the ileocecal valve during an enema examination in ileocecal tuberculosis calls for little attention except in the presence of a gaping

[1] From Eagleville Sanatorium, Eagleville, Penna., and the Albert Einstein Medical Center, Northern Division, Philadelphia, Penna. Supported in part by the Louis Sitnek Fund, Eagleville Sanatorium. Accepted for publication in February 1953.



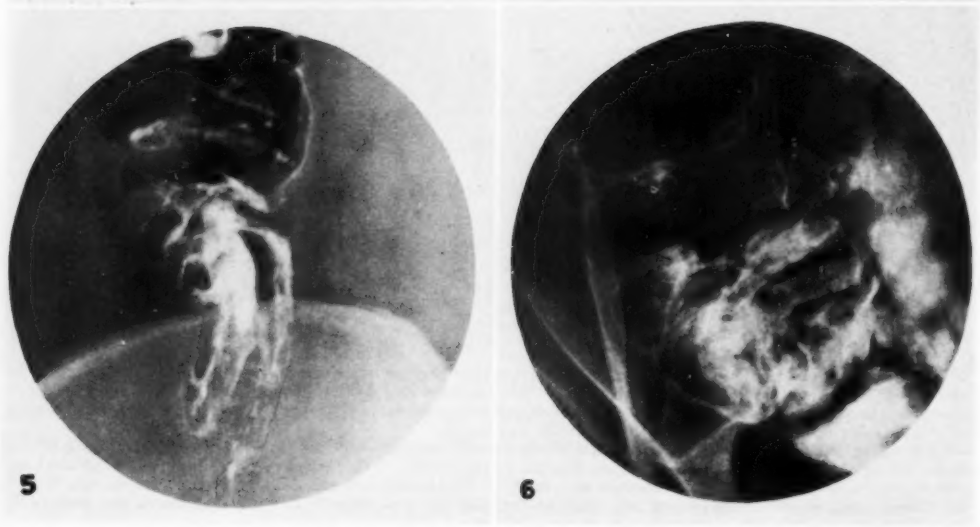


Fig. 3. The broad-based defect of a closed ileocecal valve is irregular in outline due to cecal tuberculosis (slightly retouched by pencil outline). This was confirmed at operation for appendectomy twenty-four hours after x-ray examination.

Fig. 4. Moderately advanced granulomatous tuberculosis; the spindle-like defect of the closed ileocecal valve is enlarged and of irregular contour. The appendix was removed three days after the x-ray studies. The cecal walls were thickened locally in the ileocecal area and enlarged lymph nodes were found nearby. One of these was sectioned and the presence of tuberculosis confirmed. This patient had far advanced bilateral fibro-ulcerative pulmonary tuberculosis.

Fig. 5. Gaping ileocecal valve, irregularly distorted and outlined in a case of advanced ileocecal tuberculosis, with shortening and contraction of the cecum. (The outlines of the poorly coated cecum and terminal ileum have been partially retouched by pencil lines.) This patient died with far advanced pulmonary and ileocecal tuberculosis.

Fig. 6. Thick, rigid, gaping lips of ileocecal valve due to tuberculous infiltration. This patient had a tuberculous appendix removed two months earlier, at which time she also had moderately advanced cavernous tuberculosis in the right upper lobe.

valve due to induration and fibrosis of the edges. In such cases, the disease is usually quite advanced, involving the terminal ileum and cecum.

In the early stages of ileocecal tuberculosis, there may be much spasm and yet the ileocecal valve may be incompetent. If actual ulceration or granulation tissue formation has occurred, there may be some irregular thickening of the valvular surfaces, either on the cecal or the ileal side. Various distortions of the valve will then be seen, and these must be distinguished from normal variations (Figs. 1 and 2). If these distortions occur in a patient with pulmonary tuberculosis, in the presence of shortening and contraction of the cecum or other roentgenographic signs of ileocecal tuberculosis, they may be interpreted as resulting from disease, without much risk of error (5). If the tuberculous lesions are in the cecum and confined to the cecal surfaces of the valve, the distortion may be manifested on the cecal walls rather than on the valve itself. This results in a broad-based triangular defect spanning the opening of the valve (Fig. 3). If the inflammatory changes extend into the region of the frenula, then the filling defect may extend transversely across the entire width of the cecum (Fig. 4). When the inflammatory changes are more pronounced on the ileal side of the valve, marginal stippling may be seen extending into the valve from the terminal ileum. In these cases, considerable fibrosis is present in and around the valve itself; patency may then persist and is often associated with considerable shortening and contraction of the cecum (Fig. 5). Sometimes, only the edges of the valvular lips may become contracted by fibrosis. Such distortions are also associated with incompetency of the valve (Fig. 6). If the edges of the valve are ulcerated, the inverted umbrella-like defect described by Fleischner (2) may occur (Fig. 7). This is characterized by a gaping opening where the closed apex of the valve should normally be.

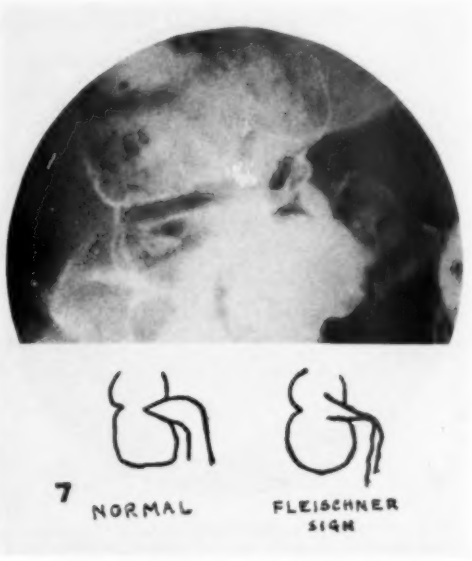


Fig. 7. Ulcerated edges of the ileocecal valve causing Fleischner or inverted-umbrella defect. The apex of the valve normally points into the cecum, whereas in this defect it points away from the cecum. This patient had pulmonary tuberculosis for five years, with a cavity 3 cm. in diameter in the left upper lobe at the time of enema examination.

In the healing stages of fibro-ulceration, the fibrosis in the region of the ileocecal valve may be so great as to cause a retraction of the medial wall of the cecum, drawing the cecum upward and medially. This can be associated with partial obstruction (Fig. 8). In contrast to the early stages, when irritability and spasm are present, the late stage of fibrous tuberculosis is characterized by rigidity of the walls, with retention of the contents (Fig. 9).

All the functional disturbances and pathological changes which occur in and around the ileocecal valve in tuberculosis may be observed in one form or another in other inflammatory processes, such as ulcerative colitis, regional ileitis, sarcoidosis, amebiasis, etc. While the differential diagnosis rests chiefly upon the other aspects of the clinical picture, nevertheless, detailed attention to the ileocecal valve and its immediate surroundings can be of much diagnostic aid in ileocecal tuberculosis.

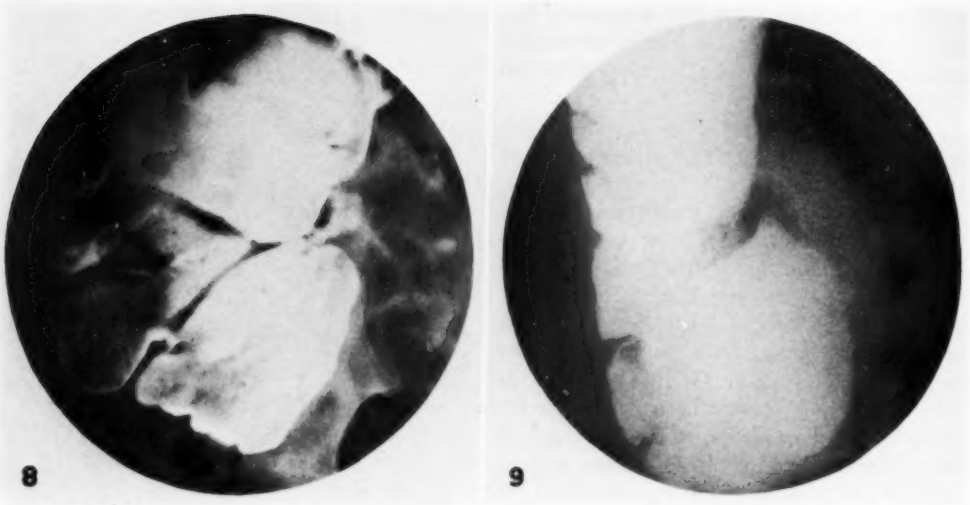


Fig. 8. Shortening and contraction of the cecum, which is rotated upward and medially, with stenosis of tuberculous ileocecal valve. This patient had pulmonary tuberculosis for thirteen years. The presence of ileocecal tuberculosis was established at the time of appendectomy, eight years before this roentgenogram was obtained.

Fig. 9. Advanced ileocecal tuberculosis. The cecal walls are thick and fibrous, and this post-evacuation film shows retention of contents. The patient died five weeks after this x-ray study, with advanced pulmonary, renal, and ileocecal tuberculosis. The distorted thickening of the valve itself was due to tuberculous infiltration.

SUMMARY

The effects of tuberculosis on the ileocecal valve as they are encountered by the roentgenologist are detailed. These details concern irritability and spasm in the early stages; rigidity and impaired motor activity in the later stages. The peculiar distortions of the valve itself due to early and late stages of ileocecal tuberculosis are described, and the value of these findings in the roentgenographic diagnosis of ileocecal tuberculosis is stressed.

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SUMARIO

Estudios Roentgenológicos de la Válvula Ileocecal en la Tuberculosis Ileocecal

Descríbense los efectos de la tuberculosis sobre la válvula ileocecal según los observa el radiólogo. La irritabilidad y el espasmo son típicos de las primeras etapas de la invasión, en tanto que la rigidez y la insuficiente actividad motora constituyen manifestaciones tardías. Aparecen varias deformaciones de la válvula, que exigen diferenciación de las variaciones normales y de otros procesos inflamatorios.

Wide-Angle Trifocal Eyeglasses for Radiologists[1]

D. ALAN SAMPSON, M.D.

Philadelphia, Penna.

THE ADVANTAGES of trifocal eyeglasses over bifocals, particularly for presbyopic radiologists, have been explained by Spillman (1). More recently Miles (2) has reported his successful results in providing trifocals instead of bifocals in a group of 50 persons of various occupations. The present report concerns an improved design for trifocals, especially suitable for radiologists.

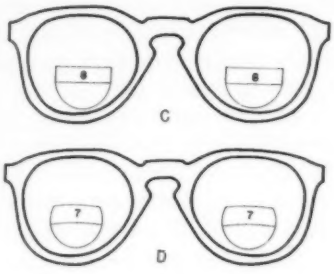

Fig. 1. C. Common type of trifocals. These sometimes are supplied with a 6 mm. middle segment, but 6.4 mm. or 8 mm. is preferable. Division between top and middle segments should be at pupillary level.

D. Alternate design of ordinary trifocals, middle segment 7 mm., also satisfactory for general use.

The principle of trifocal eyeglasses is simple. Each lens consists of three instead of two components, as in bifocals. The upper component or segment carries a correction for distant vision, the lower segment is corrected for near vision, while an intermediate segment carries the correction for "middle" distances. The intermediate correction is usually midway between the accommodation correction of the top and bottom segments, 50 per cent of the difference. Thus, if the correction for distant vision is 1 diopter, and 2 diopters are added for near vision (to give a total of 3 diopters), the correction for middle-distance vision would be a total of 2 diopters. Again, if distant vision requires no correction, and near vision 2 diopters, the intermediate segment would be 1 diopter. The reader who desires more detailed information regarding technical ophthalmological factors will profit by reading Miles' article.

Fig. 2. Experimental trifocals devised by the writer, with cemented lenses in satisfactory combination. Note Newton's rings.

The question may properly be asked, "When a presbyopic correction becomes necessary, should trifocals be used invariably or will bifocals suffice in some cases?" This has been well answered by Ellerbrock and Zinnecker (3) of Ohio State University, who have studied the relationship between amplitude of accommodation and the amplitude which should be kept in reserve in various degrees of presbyopia. When the vision reaches the stage where bifocals are needed, these will be adequate for clear and comfortable vision provided the near addition is less than 1.25 diopters. When the near addition is 1.25 diopters or more, trifocals are indicated to provide the intermediate correction so lacking with bifocals in these cases. The transition between distances with multifocal lenses is so imperceptible and effortless, and such clarity of vision is obtained at all distances, that trifocals can quite rightly be referred to as "continuous vision lenses."

[1] Presented before the Philadelphia Roentgen Ray Society and the Pennsylvania Radiological Society in May 1952, and (in Spanish) at the Inter-American Congress of Radiology in November 1952. Accepted for publication in December 1952.

In the ideal trifocals, the components should be so proportioned that each constitutes a comfortably usable part of the whole lens. Ordinary trifocals (Fig. 1), while excellent for general use, do not provide an adequate field for intermediate vision for the radiologist viewing films. For instance, the 6-mm. middle segment of one type of trifocals gives vertical coverage of only about 25 per cent of a 14 × 17-inch film; thus the radiologist must continuously tilt his head to scan the films, a tedious and trying procedure. Through an 8-mm. middle segment about 40 per cent of the film is seen, a moderate improvement. To a lesser extent, the "near" segment has a similar deficiency; for close inspection of small portions of films it is necessary to hold the head uncomfortably high because of the relatively small size of this segment.

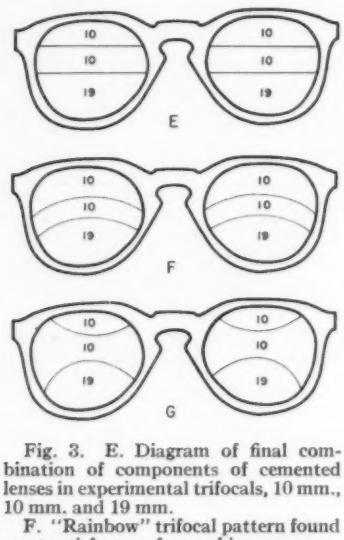

Fig. 3. E. Diagram of final combination of components of cemented lenses in experimental trifocals, 10 mm., 10 mm. and 19 mm.

F. "Rainbow" trifocal pattern found most satisfactory for working purposes. Segment widths as indicated. This pattern may also be obtained with narrower middle and bottom segments and wider top segment for general use.

G. "Baseball" trifocal pattern. Bottom segment 19 mm. high. Bovard uses 15 mm. and 5.5 mm. for middle and top segments respectively. Writer prefers 10 mm. and 10 mm.

To determine segment proportions that would be suitable for film reading, a pair of experimental trifocals with movable components was prepared for the author (Figs. 2 and 3E). Full-sized eyeglass lenses were ground with correction only for intermediate distance. Supplementary smaller lenses were ground and cemented to these with balsam, negative or minus upper components for distant vision and positive or plus lower components for near distance, to achieve the same prescription results as trifocals previously used. From time to time these supplementary lenses were removed and were recemented at new levels to determine the most suitable division of the fields of vision. From these experiments a segment distribution of 10 mm. for distance, 10 mm. for intermediate, and 19 mm. for near vision was derived; it has been given a thorough trial and found completely satisfactory. All segments are of adequate vertical size and at comfortable working levels. When viewing 14 × 17-inch films at the usual arm's length distance, about 80 per cent or more of the height of the film is seen through the middle segment without changing the position of the head; there is no discomfort or effort in the slight inclination of the head needed to scan the entire film. The bottom segment, 19 mm., gives a comfortable field of vision for ordinary reading purposes—books, newspapers, etc.—and for closely scrutinizing fine details of films. The top segment, 10 mm., is reasonably wide for distant vision. In the radiological department these glasses can be worn throughout the entire day. When film interpretation is interrupted for treatment of a patient, or for other reasons, the top segment is still wide enough to permit the radiologist to walk about in comfort and security, though hardly adequate for street use or for driving a car, for which activities they also were tested.

The cemented lenses, as described above, were an experimental makeshift, and are not recommended as a substitute for lenses ground to provide the pattern needed. Though still available as a "spare," they have an inherent disadvantage. The balsam used as cement tends, in time, to lose

its clarity, and there is a tendency to separation at the edges of the components, with the development of Newton's rings. Though the horizontal straight line division between top and middle segments is very satisfactory, it is not possible to obtain full-width straight horizontal divisions between segments when lenses are ground. Instead, each division must take the form of a curve, but this compromise does not appreciably reduce the usefulness of the trifocal pattern. Actually it improves the pattern in respect to the divison between the middle and bottom segments.

In deciding on a pattern for the lenses to be ground, the writer consulted other radiologists who had been using trifocals. A few were encountered, though Spillman was the only one who had published an account of his experiences. His glasses have a middle segment of 6 mm., with 18 mm. and 17 mm. for the top and bottom segments, respectively. As already stated, the writer has found that a 6-mm. middle segment is too narrow. Some radiologists were found who use similar lenses, but with an 8-mm. middle segment, which they claimed to be fairly satisfactory. Henderson (4) uses type D (Fig. 1) and type F (Fig. 3), preferring the former for film interpretation. His type F glasses have a bottom segment of only 10.5 mm., intermediate 9 mm., and upper 22.5 mm. It will be noted that the intermediate segment is too low in position and the bottom segment too narrow to be convenient and comfortable for film viewing at intermediate and near distances. Bovard (5) uses glasses with a modified "baseball" pattern, similar to type G (Fig. 3), using 19 mm. for the near segment, 15 mm. for the intermediate, and 5.5 mm. for the distant, and reports them satisfactory. Guided by the experiences of these radiologists, the writer had lenses ground according to the design shown in Figures 3G and 4, somewhat similar to Bovard's, but using the dimensions derived from the experiments with the cemented trifocals, 10 mm. each for the upper and middle segments and 19 mm. for the bottom segment. The glasses ground according to this pattern have been in daily use for many months; they have been found satisfactory as "working trifocals," for film reading and also have proved comfortable for reading. It is believed that this distribution of the

Fig. 4. Photograph of "baseball" type trifocals (Fig. 3 G).

Fig. 5. Photograph of "rainbow" type trifocals (Fig. 3, F), the ideal pattern for radiologists and others needing working trifocals with a large field of vision for intermediate distance.

segments is even better than that employed by Bovard in that they have a distant segment of fairly good width, while still furnishing adequate fields for intermediate vision and for near vision.

After using type G for several months, the writer has also had trifocals of type F ground (Figs. 3 and 5), somewhat similar to those of Henderson, but using the proportions derived from the experiments with the cemented trifocals. He has found this "rainbow" pattern even more satisfactory than the "baseball" pattern. In F and in G the bottom segments are identical in height, 19 mm., and in shape. The intermediate segments have the same vertical dimension of 10 mm. centrally. The downward sweep of the upper limit of the intermediate segment in the "rainbow" pattern does not in any way curtail the usefulness for intermediate vision. It actually gives a much broader field of distant vision, with the result that the glasses are even more convenient than those of

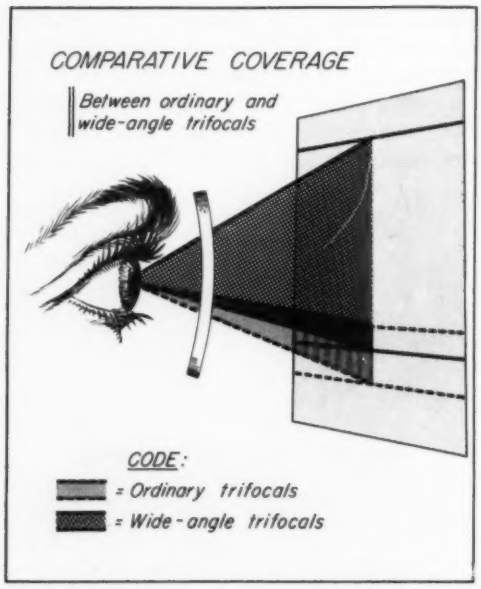

Fig. 6. Comparative coverage of x-ray film as seen through ordinary and wide-angle trifocals. The intermediate field covered by wide-angle lenses has much greater vertical width and also is at a higher level than with ordinary trifocals.

the "baseball" pattern for the frequent occasions when distant vision is needed. In addition, they have been found convenient for use during surgical procedures; their broad upper segment gives an ample field of distant vision, while the intermediate and near segments are placed at the most comfortable and convenient levels for work at these closer distances. Such lenses may be regarded as ideal for the presbyopic radiologist.

SUMMARY

Trifocal eyeglasses of various patterns have been tested, and experiments have been conducted with movable components. For general use the optimum middle segment is 6.4 to 8.0 mm. in height, with its upper limit at the pupillary line. For film reading an intermediate segment of 10 mm. is desirable, with its lower limit at the pupillary line. These segment proportions, in a "rainbow" pattern, have been found by the writer and others to be eminently satisfactory. "Working trifocals" of the pattern described will be found a useful adjunct for the radiologist reading films as well as for the surgeon at the operating table, the dentist, and others.

Suburban Square Bldg.
Ardmore, Penna.

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SUMARIO

Lentes Trifocales de Angulo Ancho para Radiólogos

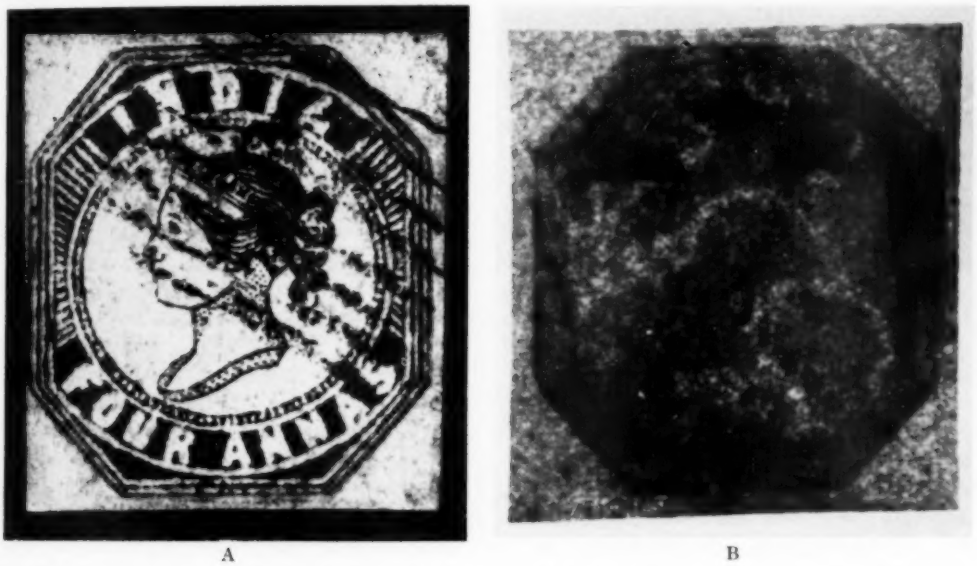
En las lentes trifocales destinadas a empleo general, el segmento medio óptimo tiene de 6.4 a 8.0 mm. de alto, quedando el límite superior en la línea pupilar. Para la lectura de radiografías, conviene un segmento intermedio de 10 mm., cuyo límite inferior quede en la línea pupilar. Esas proporciones de los segmentos, en forma de "arco iris" (Fig. 5), han resultado sumamente satisfactorias al A. y a otros. "Trifocales prácticos" de ese estilo resultarán ser un accesorio útil para el radiólogo en la interpretación de las radiografías.

X-Rays in Philately[1]

HERBERT C. POLLACK, M.D.,[2] and CHARLES F. BRIDGMAN[3]

As is well known, radiography provides a means for non-destructive analysis in many fields outside of medicine and medical research. Perhaps the industrial applications have received the most publicity, but x-rays have been similarly employed in such fields as archaeology, paleontology, geology, biology, conchology, zoology, and entomology. One of the best known non-medical and non-industrial uses of radiography is in art museums, where paintings are examined for analysis of the paint, canvas, paper, or wood base. Quite recently similar investigations have been made in the field of philately, or stamp collecting.

A postage stamp consists basically of a design printed on a small piece of thin paper. It is important to the collector to be able to differentiate various characteristics of stamps. These include: (1) the method of printing, such as intaglio, letterpress, offset, photogravure, or other process; (2) the type of paper—woven, laid, ribbed, pelure, etc.; (3) watermark, if any, in the paper. Such information is essential in cataloguing stamps for collections or sales. Many stamps are of high value, selling for hundreds and even thousands of dollars if in good condition and genuine. Years ago clever counterfeiters created reproductions of quite a few of these high-value stamps. Nowadays the unscrupulous artisan will not forge an entire stamp, but he is able to increase the value of a genuine stamp by



A B

Fig. 1. A. Photograph of 4-annas stamp of the 1854 issue of India.
B. Electronograph shows that the octagonal center has been pasted on a square of new paper. The new paper did not contain a watermark.

[1] Based upon material presented as a Scientific Exhibit at the Thirty-eighth Annual Meeting of the Radiological Society of North America, Cincinnati, Ohio, Dec. 7–12, 1952. This exhibit was awarded Honorable Mention.

[2] Radiologist, Chicago, Illinois.
[3] Rochester, New York.

A B

Fig. 2. A. Photograph of 3-Groschen stamp of the 1858 issue of Oldenburg, Germany.
B. Autoelectronograph. Paper had been added to the upper right corner that had been torn off. The design was redrawn with aniline ink instead of the metallic ink used in the original. The repaired area is clearly demonstrated.

repairing torn or thin areas of the paper, adding paper to narrow margins (Fig. 1), replacing perforations that have been torn off, and chemically removing cancellations. He also will redraw the design where damaged (Fig. 2). Such repairs frequently are impossible of detection by the naked eye, the microscope or ultraviolet light. Hence, such alterations may be overlooked even by the advanced philatelist.

The application of x-rays has made it possible to study the minute details of the design, paper texture, watermark, and cancellation of the postage stamp. One can facilitate determination of authenticity by comparing the radiographic image of a genuine with that of a questionable stamp. Repaired areas will usually show as clearly on the radiograph as would a fracture of a long bone.

Such analysis is made possible by the use of three different technics: low-voltage radiography, autoelectronography, and electronography. Each procedure reveals certain aspects of the stamp not readily apparent with the others.

TECHNICS

Low-Voltage Radiography: Because postage stamps are printed on such thin paper and offer so little absorption, x-rays of very long wave length must be employed. We have found that a beryllium window tube operated at 6 kv. is most satisfactory. The designs and cancellations of stamps are printed with inks whose color is derived from metallic pigments such as mercuric oxide, lead oxide, etc., or from organic substances such as carbon and the aniline dyes. The former group will normally absorb x-rays to a much greater extent than the latter. This ability to differentiate between inks is one of the chief values of low-voltage radiography. For example, the design of a stamp may be printed with a metallic ink and a large smudgy carbon cancellation may obliterate certain key portions of the design that are important

for cataloguing purposes. Inasmuch as the cancellation ink will not strongly absorb the x-rays, the resulting radiograph will show only the image of the actual design. The paper usually absorbs very little of the x-rays and hence is only faintly visible on the radiograph. It sometimes will show enough, however, so that the watermark can be recognized and its position noted with respect to the design.

Autoelectronography: Very high-voltage x-rays also may be employed in the examination of stamps. X-rays generated at about 200 kv. are used and heavily filtered with 7 mm. of copper at the tube. When this technic is employed, stamp inks made with metallic pigments will emit electrons (the higher the atomic number, the greater the emission). Organic inks used for designs or cancellations will produce only a faint, almost imperceptible electronic emission image. Of course, an organic ink in which the organic molecule contains a heavy atom will have a greater emission than one which contains *only* light atoms such as carbon, hydrogen, and oxygen. The emission of electrons from pigments will also depend upon their concentration in the ink or upon the heaviness of the printing. Only a slight image of the paper on which the stamp is printed is recorded. The design may thus be studied without the superimposition of the paper structure as seen in the low-voltage radiograph.

Electronography: Electrons may be employed in still another way for the investigation of postage stamps. If a sheet of lead foil about 0.005 inch thick, such as is used in industrial radiography in lieu of an intensifying screen, is laid on top of the stamp and film and irradiated with hard x-rays, the lead will emit its own characteristic radiation. As in the previous technic 200-kv. radiation is employed, with 7 mm. of copper filtration at the tube. Since electrons are strongly absorbed by thin, light materials, the electronograph will show differences in the paper thickness of the stamp, giving an image of the texture as well as the watermark, if present. There will be no image of the design, even if printed with a metallic ink, not only because the stamp is placed face uppermost on the film, but also because the intensity of emission from the ink is small compared with that from the lead foil.

The use of x-rays in philately is still in an experimental phase. With improvements foreseen in technic, as well as a widening of the scope of the investigations, this form of analysis will become one of the most conclusive tools of the stamp expert.

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SUMARIO

Los Rayos X en la Filatelia

La radiografía ha resultado de valor en el estudio de los sellos de correo, sobre todo para descubrir las reparaciones verificadas en estampillas defectuosas, a fin de aumentar su valor, rectificar diseños estropeados, etc. Con el uso de los rayos X cabe observar los delicados detalles del diseño del sello, la contextura del papel, las filigranas y los matasellos. Hay tres técnicas aplicables al problema: (1) la radiografía de voltaje bajo; (2) la autoelectronografía; (3) la electronografía.

Eugene P. Pendergrass, M.D.

President of the Radiological Society of North America

EDITORIAL

Eugene P. Pendergrass, M.D.

President of the Radiological Society of North America

Leader, teacher, doctor, friend—such was the promise which lay ahead of the boy in the little town of Florence, South Carolina, in the year 1910. At the age of fifteen, his public school years were nearing an end. The summers spent helping his father in the grocery store were soon to be replaced by a business career as a cotton-buyer, in association with his father. Profits were good until the onset of the First World War, when the cotton market dropped, and, in Eugene Pendergrass' own words, "it was necessary for me to do something else . . . at that time I elected to go into medicine." By such a narrow turn were his accomplishments assured for medicine, and eventually radiology.

Eugene Pendergrass was born in 1895, one of several children in the household of Edward J. and E. Ethel Smith Pendergrass. His parents hoped that he would be a preacher and, indeed, a younger brother is today a Methodist minister in Orlando, Florida. But contacts with a local physician of outstanding attainments, Dr. Frank H. McLeod, coupled with stories about his grandfather who had been a physician, influenced Eugene and a cousin, Hugh Smith, to decide jointly on a medical career. In pursuit of this, Eugene went first to the University of North Carolina and then to the School of Medicine of the University of Pennsylvania, from which he received his degree in medicine in 1918.

During his college days he "majored" in athletics and was on the baseball, football, and track teams. He had experience in local semi-pro baseball as a pitcher and first baseman. Looking back on this period, Dr. Pendergrass has written: "My interest in athletics sometimes interfered with my studies, and I am sure I never really learned to study profitably until after I got into medicine"—a masterly understatement, in which one may see illuminated the youth and the man.

Immediately after graduating from medical school, the young doctor entered the Navy but was sent back to the Hospital of the University of Pennsylvania for further training and was there assigned to the Department of Radiology under Dr. Pancoast. Of that period Dr. Pendergrass has written: "I was very much discouraged with the assignment when I first received it, because I felt it was a great mistake to go through medical school and then be assigned to what I thought at that time was 'picture taking.' Very soon, however, under the stimulating guidance of Dr. Pancoast, I realized that I was most fortunate and applied myself diligently." Further experience came as radiologist at the Naval Hospital on Grays Ferry Road, in Philadelphia, followed by a tour of duty in France. Upon discharge from the service Dr. Pendergrass returned to work with Dr. Pancoast at the University Hospital and entered upon a career of increasing brilliance and distinction under the stimulus of this wise and kindly physician. For three years he lived with the Pancoasts, who treated him as a son. Only marriage called him away from this pleasant interlude, which is placed among his fondest memories.

On Sept. 9, 1922, Eugene P. Pendergrass and Rebecca Barker were married. Betty Pendergrass had been raised in New Brighton, Pennsylvania, and had graduated from Teachers College in New York to enter the teaching profession be-

fore her marriage. Betty and Gene have three fine children, of whom they are justly proud. Henry is in his first year of residency training in Radiology with his father at the University Hospital. Jane and Peggy are recently and happily married and live not far from their parents.

The professional attainments of our incoming president reflect a great intellectual capacity, combined with a vigorous, self-disciplined personality. He has been Professor of Radiology in the School of Medicine at the University of Pennsylvania since 1936 and Director of the Department of Radiology at the University Hospital since 1939. The esteem in which he is held by those whom he has trained has led to the formation of the Association of Pendergrass Fellows, an organization with well over a hundred members, who assemble from all parts of the country annually to attend a banquet in his honor.

He has been a member of the Committee on Radiology of the National Research Council for many years and its Chairman since 1948. He has been active and held high office in the American Cancer Society since 1942. He has been President of the American College of Radiology and Chairman of the Board of Chancellors of that organization. He has been a member of the Board of Directors of the Radiological Society of North America and was chairman of that body in 1952. Finally, he has been an outstanding leader in many organizations in Philadelphia medicine and President of the Medical Board of his own University Hospital from 1949 to 1952.

Dr. Pendergrass is an international figure in radiology. He holds honorary memberships in national radiological societies of no less than seven foreign countries, and is secretary-general of the approaching Fifth Inter-American Congress. Among his contributions to military radiology was his presence at "Operation Cross-Roads" at Bikini in 1946 as a member of the radiological safety committee.

As a teacher and investigator, Dr. Pendergrass has added much to the art and science of radiology. Author of over 180 medical papers, he has yet found time to write an outstanding book, *The Head and Neck in Roentgen Diagnosis*, published by Charles C Thomas in 1940.

Such is the physician and leader. To other ends, Gene Pendergrass finds the time to be a keen competitor in golf and sailing, skillful fly fisherman, and an irrepressible poker player. His innumerable friends will call up from these prosaic sentences, the vibrant personality they love. To those of you who do not know him, a great experience awaits you in his meeting. ROBERT P. BARDEN, M.D.

The Thirty-Ninth Annual Meeting

The largest meeting ever held of the Radiological Society of North America took place at the Palmer House, Chicago, Dec. 13 to 18, 1953. The day before the formal opening, Sunday, Dec. 13, the Therapy Information Session started the ball rolling, with Milton Friedman as moderator. In the evening at the Film Interpretation Session, Philip Hodes led the assembly of diagnosticians on wild goose chases to the enjoyment of all.

Monday saw the start of the formal meeting. President Ira H. Lockwood called the meeting to order and Walter C. Bornemeier, M.D., President of the Chicago Medical Society, delivered the address of welcome. Dr. Lockwood then spoke in response.

This year the scientific sessions were divided into two sections, held separately in the morning and together in the afternoon. The morning program of Section A was devoted to diagnostic problems and that of Section B to particular therapy problems, physics, isotopes, and radiobiology. The combined sessions were concerned with matters of general diagnostic and therapeutic interest.

Officers of the Radiological Society of North America

Front row, left to right: Dr. Ira H. Lockwood, Retiring President; Dr. Eugene P. Pendergrass, Incoming President; Dr. Donald S. Childs, Secretary-Treasurer; Dr. Tom B. Bond, President-Elect. Rear row: Dr. Clarence E. Hufford, Chairman of the Board of Directors; Dr. William E. Costolow, First Vice-President; Dr. Howard P. Doub, Editor of RADIOLOGY; Dr. Leslie K. Sycamore, Retiring Third Vice-President; Dr. Charles H. Heacock, Retiring First Vice-President.

As is usual, the Refresher Courses were well attended and well received. Very few courses were not "sold out." In this connection a reminder may be in order: Apply for tickets early and do not apply unless you are going to use them. You may be excluding someone else.

On Tuesday evening, the Annual Carman Lecture was delivered by Dr. Roger Allen Harvey. After Dr. Lockwood had detailed his many titles and his rich experience, Dr. Harvey had perforce to give an excellent lecture. His "Observations in Atomic Medicine" was a complete review in which, concisely and with interest, he brought his listeners up to date on this important subject.

During the meeting the Ladies Committee under the able direction of Mrs. John H. Gilmore did yeoman duty. Chicago is a fine city for meetings and for side activities. These latter were well attended, though the fact that the meeting occurred so close to Christmas may have been something of a deterrent to full participation, not to mention its effect on a number of husbands' pocketbooks.

The Annual Banquet was, as usual, a gala occasion. Following an excellent meal and the famed procession of lighted iced desserts, climaxed by the letters R S N A at the speakers' table, the Gold Medal of the Society was presented to Dr. Leo G. Rigler. After introducing the prominent members and guests, Dr. Lockwood turned the gavel over to Dr. Eugene Pendergrass, the incoming president. President Pendergrass made a brief address, and the remainder of the evening was devoted to conviviality and dancing.

A few statistics may be in order. Registration on the final day showed 767 members, 707 guests, 683 exhibitors, 234 ladies. A grand total of 2,391. A most impressive figure!

The new officers of the Society are: President, Eugene P. Pendergrass, M.D.; President-Elect, Tom B. Bond, M.D.; First Vice-President, Wm. E. Costolow, M.D.; Second Vice-President, Arthur C. Singleton, M.D.; Third Vice-President, J. Rush Shull, M.D. Dr. Laurence L. Robbins was elected to the Board of Directors.

JAMES W. J. CARPENDER, M.D.

The Refresher Courses

The Refresher Courses of the Thirty-ninth Annual Meeting of The Radiological Society of North America again enjoyed a great success. A total of 47 courses were given at the Palmer House in Chicago, with an enrollment of over 1,200 persons from all parts of the United States, Canada, Mexico, Cuba, and South America. This represents the largest number ever to take advantage of this important feature of the Annual Meeting.

We are deeply indebted to the following instructors for their excellent presentations and to the members of the various panels in the film reading and therapy information sessions:

Oscar V. Batson, M.D.
James Bierly, M.S.
Robert Bloor, M.D.
Edward A. Boyden, Ph.D.
Carl B. Braestrup, B.S.
Ralph M. Caulk, M.D.
W. Edward Chamberlain, M.D.
George W. Chamberlin, M.D.
Henry C. Crozier, M.D.
Alfred A. J. Den, M.D.
Edwin C. Ernst, M.D.
Titus C. Evans, Ph.D.
Sergei Feitelberg, M.D.
Melvin M. Figley, M.D.
Elizabeth F. Focht, B.A.
Milton Friedman, M.D.
Lillian Fuller, M.D.
Cesare Gianturco, M.D.
Roy R. Greening, M.D.
E. J. Hart
George C. Henny, M.D.
Philip J. Hodes, M.D.
Paul C. Hodges, M.D.
John F. Holt, M.D.
P. Boland Hughes, M.D.
Leon O. Jacobson, M.D.
H. Kelikian, M.D.
L. L. Klostermyer, M.D.
John S. Laughlin, Ph.D.
Maurice Lenz, M.D.
Elbert K. Lewis, M.D.
Charles L. Martin, M.D.
Jean Meszaros, M.S.
William Morgan
James J. Nickson, M.D.
Ralph Overman
H. M. Parker, M.Sc.
Eugene P. Pendergrass, M.D.
R. S. Quick, B.Sc.
Juan A. del Regato, M.D.
Robert Robbins, M.D.
Roberts Rugh, Ph.D.
Richard Schatzki, M.D.
Wendell G. Scott, M.D.
L. S. Skaggs, Ph.D.
Howard L. Steinbach, M.D.
M. Noel Stow, M.D.
Paul C. Swenson, M.D.
Harvey White, M.D.
Harry Zinsser, M.D.
Raymond E. Zirkle, Ph.D.

We also wish to extend most hearty thanks from the Refresher Course Committee and the Radiological Society to the local committee on Refresher Courses, headed by Dr. E. K. Lewis.

REFRESHER COURSE COMMITTEE
Robert P. Barden, M.D.
Robert C. Pendergrass, M.D.
Edith H. Quimby, Sc.D.
John W. Walker, M.D., *Chairman*

The Scientific Exhibits

The 1953 Scientific Exhibits section contained fewer exhibits than in some of the past years, but somewhat more than in 1952—42 in all, exclusive of Gadget Row and the Society's own exhibit of the Pfahler Gavel. As is apparent from the listing below, a great variety of material was included.

A number of innovations are worthy of note. The Pfahler Gavel was on display for the first time, being shown in a new, specially designed case. We were fortunate to have in the display the text of the original presentation in Dr. Pfahler's own handwriting. Thus many were afforded the opportunity to see this revered object.

Another innovation was the exhibit on Cineradiography. While this subject has been treated in previous years by a single exhibitor, the program this time afforded an opportunity for several individual contributors or exhibitors to demonstrate what they have done in this rapidly advancing medium of study and diagnosis.

The secret Committee on Awards for the Scientific Exhibits made the following awards and commendations:

The Committee wishes to commend the concept and execution of the Society's exhibit on the Pfahler Gavel.

Fundamental Investigation

Cum Laude. Thermal Neutron Therapy of Glioblastoma. JOHN T. GODWIN, M.D., AND E. STICKLEY, PH.D., Upton, Long Island, N. Y.

Certificate of Merit. Xeroradiography. JOHN F. ROACH, M.D., AND HERMAN E. HILLEBOE, M.D., Albany, N. Y.

Honorable Mention. Attenuation Voltmeter. R. R. NEWELL, M.D., San Francisco, Calif., AND GEORGE HENNY, M.D., Philadelphia, Penna.

Clinical Investigation

Cum Laude. Resilient Plastic Replicas of Surgical Pathology and Their Clinical Application. CLEMMER M. PECK, M.D., FORREST V. SCHUMACHER, M.D., AUBREY O. HAMPTON, M.D., Washington, D. C., AND JOHN V. NIIRANEN, D.D.S., Bethesda, Md.

Certificate of Merit. A Topographic Approach to the Roentgenological and Pathological Examination of Laryngo-Pharyngeal Tumors. GILBERT H. FLETCHER, M.D., GEORGE S. LOQUVAM, M.D., AND JACOB W. OLD, M.D., Houston, Texas.

Honorable Mention. (1) Roentgenological Bone Changes Encountered in Frostbite, Korea 1950–1951. HAROLD A. VINSON, M.D., Fort Knox, Ky., AND RICHARD SCHATZKI, M.D., Brookline, Mass.

(2) The Deep Cerebral Veins in Cerebral Angiography. BERNARD S. WOLF, M.D., BENNO SCHLESINGER, M.D., AND CHARLES M. NEWMAN, M.D., New York, N. Y.

(3) A Modern Planning System for the Roentgen Therapy of Deep-Seated Cancer. BERNARD ROSWIT, M.D., GUSTAVE KAPLAN, M.D., AND ELAINE ROSEN, B.A., New York, N. Y.

Chief Gadgeteer:

HENRY C. CROZIER, M.D., Los Angeles, Calif., for his Improved Barium Enema Pump.

The Committee wishes to recommend that special commendation be given to the authors of the material in the Cineradiography Exhibit for an excellent presentation.

Other exhibits, arranged according to the alphabetical order of the exhibitors, were:

Intestinal Manifestations of Disseminated Scleroderma, HERBERT L. ABRAMS, M.D., San Francisco, Calif.

Intravenous Cholangiography, A. L. L. BELL, M.D., LEWIS L. IMMERMAN, JEROME ZWANGER, M.D., J. P. ARCOMANO, M.D., AND E. T. BELLO, Brooklyn, N. Y.

Arteriography in Vascular Injuries, HARRY L. BERMAN, M.D., LEONARD H. SEITZMAN, M.D., AND EDWARD J. JAHNKE, M.D., Washington, D. C.

Comparative X-Ray and Pathologic Findings in Resected Lung Specimens, CARL C. BIRKELO, M.D., F. M. VOELZ, M.D., AND P. C. MARTINEAU, M.D., Detroit, Mich.

Roentgenologic and Dermatologic Manifestations of Certain Systemic Conditions, ANDRÉ BRUWER, M.D., AND R. R. KIERLAND, M.D., Rochester, Minn.

Radioactive Iodine Tracer Studies in Legg-Perthes Disease, KENNETH E. CORRIGAN, PH.D., Detroit, Mich., R. W. EMERICK, M.D., A. H. JOISTAD, M.D., AND L. E. HOLLY, M.D., Muskegon, Mich.

Carcinoma of Cervix, EDWIN C. ERNST, M.D., St. Louis, Mo.

Clinical and Experimental Uses of Macroradiography, LEWIS E. ETTER, M.D., Pittsburgh, Penna.

Localization of Placental Site with Soft Tissue Films, LAURA FARIÑAS, M.D., AND R. A. GOMEZ ZALDIVAR, M.D., Habana, Cuba.

Volvulus of the Colon, LEO S. FIGIEL, M.D., AND STEVEN J. FIGIEL, M.D., Detroit, Mich.

Kerosene Poisoning in Infants and Children, JOSEPH C. FOLEY, M.D., A. B. SOULE, JR., M.D., NICHOLAS B. DREYER, M.D., AND EPHRAIM WOLL, M.D., Burlington, Vt.

Double Contrast Studies of the Colon and Studies of the Small Intestine, SIDNEY E. FOSTER, M.D., San Francisco, Calif.

The Influence of Body Posture on Heart Size and Configuration, J. E. HABBE, M.D., H. H. WRIGHT, M.D., AND C. E. SCHMIDT, M.D., Milwaukee, Wis.

Radiogold Seeds in Radiation Therapy, ULRICH K. HENSCHKE, M.D., AND WILLIAM G. MEYERS, PH.D., Columbus, Ohio.

Routine Admission Chest X-Rays Program of the Los Angeles County Hospital, GEORGE JACOBSON, M.D., AND DENIS C. ADLER, M.D., Los Angeles, Calif.

Experiences with a 4 Valve, Full Wave Rectified Mobile X-Ray Generator Equipped with a Rotating Anode Tube Having 1.5 and 0.3 mm. Focal Spots, HENRY H. JONES, M.D., AND GEORGE MAHONEY, R.T., San Francisco, Calif.

Congenital Megacolon (Hirschsprung's Disease), GEORGE P. KEEFER, M.D., AND JOHN F. MOKROHISKY, M.D., Philadelphia, Penna.

Benign and Malignant Gastric Ulcers: Roentgen Differentiation, I. E. KIRSH, M.D., Hines, Ill.

Venous Aneurysms of the Mediastinum, TED F. LEIGH, M.D., OSLER A. ABBOTT, M.D., J. V. ROGERS, JR., M.D., AND BRIT B. GAY, JR., M.D., Atlanta, Ga.

Radiological Examination of the Injured Patient, D. R. LIMBACH, M.D., Flint, Mich.

The Effect of Roentgen Rays on Lepromatous Leprosy, EUGENE F. LUTTERBECK, M.D., IRVIN F. HUMMON, M.D., ROLLA R. WOLCOTT, M.D., AND FREDERICK A. JOHANSEN, M.D., Chicago, Ill.

The Treatment of Widespread Metastasis to Bone from Carcinoma of the Breast, Using Radioactive Phosphorus, J. R. MAXFIELD, JR., M.D., AND JACK G. S. MAXFIELD, M.D., Dallas, Texas.

Laminagraphy in Acute Maxillofacial Injuries, RICHARD F. MCCLURE, Lt., MC, USNR, Camp Pendleton, Calif.

Interstitial Pulmonary Infiltration without Obvious Etiological Clue, CHARLES ODERR, M.D., New Orleans, La.

Biological Effects of Cooling Water from the Hanford Reactors, H. M. PARKER, M.Sc., R. F. FOSTER, Ph.D., AND H. A. KORNBERG, PH.D., Richland, Wash.

Hereditary Deforming Chondrodysplasia, WARREN S. PEIPER, M.D., Mitchell, S. D.

A New Serialograph, S. P. PERRY, M.D., J. T. LITTLETON, M.D., AND HAROLD REYNOLDS, B.S., Sayre, Penna.

Physiological Bronchography, CHARLES A. PRIVITERI, M.D., Buffalo, N. Y.

Long Film Aortography and Femoral Arteriography in Peripheral Vascular Disease, STANLEY M. ROGOFF, M.D., JOHN L. HOLLENBACH, R.T., Rochester, N. Y.

Femoral Arteriography in Vascular Occlusive Disease, J. C. ROOT, M.D., A. W. HUMPHRIES, M.D., AND C. M. GREENWALD, M.D., Cleveland, Ohio.

Pulmonary Complications of ACTH and Cortisone: Roentgen Observations, ISRAEL STEINBERG, M.D., N. FINBY, M.D., AND J. A. EVANS, M.D., New York, N. Y.

Studies in Biliary Tract Contrast Media, WALTER M. WHITEHOUSE, M.D., Ann Arbor, Mich.

Femoral Arteriography Before and After Reconstructive Surgery, E. G. WISSING, M.D., R. WARREN, M.D., AND E. HORWITZ, M.D., Boston, Mass.

Congenital Absence of a Pulmonary Artery, STANLEY M. WYMAN, M.D., Boston, Mass.

Gadget Row again contained interesting material, with the largest number of Gadgeteers that we have had since the introduction of this feature. Exhibits in this section were as follows:

Improved Barium Enema Pump, HENRY C. CROZIER, M.D., Los Angeles, Calif.

Improved Bifocal Lens for Radiologists, WM. S. ALTMAN, M.D., Quincy, Mass.

Recording Timer for Arteriography, T. M. FULLENLOVE, M.D., San Francisco, Calif.

Variable Density View Box for Film Photography, TED F. LEIGH, M.D., Atlanta, Ga.

Improved Vaginal Radium Applicators, J. T. LITTLETON, M.D., Sayre, Penna.

Simple Pneumocolon Bottle, LEE B. LUSTED, AND E. R. MILLER, M.D., San Francisco, Calif.

Device for Children's Chest Radiography, WARREN S. PEIPER, M.D., Mitchell, S. D., AND J. J. AVERY, M.D., Arkansas City, Kans.

A notable contribution to the Scientific Exhibits section was contained in the space occupied by the American Society of X-ray Technicians. A portion of the original exhibit was lost en route, and this space was then filled by photographs depicting the day-to-day work and activities of technicians in departments of Radiology. The outstanding quality of the photography brought forth much favorable comment. The credit for these excellent photographs goes to Dr. T. F. Leigh of Atlanta, Ga.

The Scientific Exhibits Committee wishes to thank the many contributors to this section, through whose efforts we were able to have such an interesting and instructive section.

IVAN J. MILLER, M.D., *Chairman*
Scientific Exhibits Committee

The Commercial Exhibits

The largest Commercial Exhibit ever presented at a meeting of the Radiological Society of North America was assembled in the Palmer House for the Thirty-eighth Annual Meeting. The exhibit was outstanding in many respects, but particularly in the amount of heavy equipment shown and the excellent quality of the displays. Traffic through the Exhibit Section was continuous, and the interest displayed was most gratifying both to the members of the Commercial Exhibits Committee and to the exhibitors.

Brief descriptions of the individual exhibits follow:

ABBOTT LABORATORIES, INC. (North Chicago, Ill.): Supplies of isotopes packaged in vials were the feature of the Abbott Laboratories Exhibit. The minimizing of radiation exposure during handling and administration by this means is of particular advantage.

AMPEREX ELECTRONIC CORPORATION (Hicksville, N. Y.) showed a complete line of diagnostic radiographic tubes, with special emphasis on the 0.3-mm.-focal-spot rotating-anode tube.

ANSCO CORPORATION (Binghamton, N. Y.) had on exhibit samples of Ansco High Speed Medical Film, Ansco Non-screen Medical Film, and Ansco Liquid Processing Chemicals. Also featured were samples of Aids for both the radiologist and medical x-ray technician.

ATOMIC ENERGY OF CANADA, LTD. (Ottawa, Canada) displayed a working model of its cobalt 60

rotating-therapy unit, called the Theratron, featuring extreme flexibility of operation and positioning. Also shown was a scale model of the cobalt 60 fixed beam Eldorado unit.

AUTOMATIC SERIOGRAPH CORPORATION (College Park, Md.): The new Sanchez-Perez Universal Model 110 Automatic Seriograph for serial angiography was shown operating in both the horizontal and vertical position. Some of the features of this unit are: individual cassettes with screens, assuring complete contact and excellent pictures; standard cut film, and regular developing procedure; large films (11 × 14 inches) or small films (10 × 12 inches) in the same cassette; twelve exposures in a series; remote control, for starting and interrupting the picture series; automatic timer, with half a second to two seconds between exposures; cassette counter; portability and versatility.

BAR-RAY PRODUCTS, INC. (Brooklyn, N. Y.) exhibited an extensive line, featuring stainless steel processing tanks with a new positive temperature control valve; Archer lead fiber glass gowns for personnel protection; Bar-Ray stainless steel Add-A-Tank, a 3-compartment unit with two removable 5-gallon stainless steel insert tanks; and the new Bar-Ray Redi-Vue film filing system, a 5-shelf unit, holding approximately 2,500 negative envelopes, each shelf being divided into four compartments.

BARNES-HIND LABORATORIES, INC. (San Francisco Calif.): Barotrast, a specially processed and micronized barium sulfate, was featured by the Barnes-Hind Laboratories. It is easily prepared, and the resulting palatable, creamy, smooth-flowing mixture does not settle on standing. Because of its unique physical properties, Barotrast resists the effect of mucin, pH changes, and gastric secretions, therefore coating the entire gastrointestinal tract most satisfactorily. Numerous films were shown illustrating its properties, and a pneumocolon kit for its administration in air-contrast enema studies was demonstrated.

BELL CRAIG, INC. (New York, N. Y.): Neocholex, an improved agent for producing contraction of the gallbladder, and Medopaque, a water-miscible, freely flowing opaque medium, for investigation of body cavities, were shown by Bell Craig Inc.

BUCK X-OGRAPH COMPANY (St. Louis, Mo.) displayed illustrative radiographs, demonstrating the high quality of Buck x-ray film and processing chemicals.

C & P SPECIALTIES, INC. (Indianapolis, Ind.) had on display a low-cost, manually operated cassette-changing apparatus for cerebral angiography by the percutaneous or operative method. This is designed for the use of 10 × 12-inch cassettes. Accessories include a long, scatter-reducing stainless steel cone, a back rest, and two canvas sling head supports. An integral elevating device provides adjustment to produce any desired neck extension. The cassette changer is built of durable stainless steel and plastic, is portable, and can be stored conveniently when not in use.

COCA-COLA COMPANY (Atlanta, Ga.): The Coca-Cola booth graciously dispensed refreshing Coca-Cola during the meeting, earning the gratitude of all who partook of their hospitality.

CORECO RESEARCH CORPORATION (New York, N. Y.) showed a flash-bulb automatic color camera. This is available at a lower price than the standard Coreco camera and is designed for the physician who does occasional rather than routine clinical photography. Photographs illustrated the use of the camera on various body surfaces and in cavities.

DUNLEE CORPORATION (Chicago, Ill.) exhibited a full line of their products, including the new rotating anode-tube inserts and housing lines, featuring smaller housings and field replacement of inserts. Special emphasis was given to Dunlee's program of education on thoriated valve tubes and to the cylindrical anode type of design. The tilted anode tube, which makes possible greatly increased ratings of finer focal spots in self-rectified operation, was also demonstrated in a variety of tubes.

E. I. DU PONT DE NEMOURS & COMPANY (Wilmington, Del.) presented a product story, demonstrating comparative results gained from the use of par speed, hi-speed, and detailed screens. They directed attention to the products needed to obtain a good radiograph, to the uniformity of Patterson screens over the years since 1939, and to a non-interleaf x-ray film.

EASTMAN KODAK COMPANY (Rochester, N. Y.): Kodak Medical X-ray Films and Processing Chemicals were featured, along with a number of interesting items of accessory equipment. Among the latter were the new Kodak f/0.75 Fluro Ektar 110-mm. Lens for use in cinefluorography, the Kodak Radiograph Microfile Machine for the rapid copying of radiographs from files to 35-mm. film, and the Verifax Method for making immediate copies of typed or printed matter. The Kodak Radiograph Copying Unit, Kodak X-ray Processing Hangers, and Kodak X-ray Film Identification Printer, Model B, were also shown. A display of photographic equipment included the latest Kodak cameras.

EUREKA X-RAY TUBE CORPORATION (Chicago, Ill.) had on display a complete line of rotating-anode insert tubes and units, exemplifying both the solid copper-backed tungsten anode and the solid tungsten disc type anode. Included in the exhibit were new over-table and under-table 125-kv.p. units. A special feature of the under-table unit is the air circulator, which is standard equipment.

FAIRCHILD CAMERA & INSTRUMENT COMPANY (Jamaica, N. Y.) showed the Fairchild Camera for the rapid recording of radiographic images. Also shown were various film viewers for mini-film chest surveys.

H. G. FISCHER & COMPANY (Franklin Park, Ill.) exhibited a diagnostic-superficial therapy unit.

Five services are available in this one unit—grenz ray, superficial therapy, radiography up to 50 ma. at 80 kv.p., fluoroscopy, and an examining table—making it an ideal auxiliary unit for light x-ray work for hospitals and offices. The high-tension transformer, filament transformer, and x-ray tube are all enclosed in the oil-filled, shock-proof, lead-lined tube head. A beryllium window is contained in the tube.

L. M. FORSYTH MANUFACTURING COMPANY (Chicago, Ill.) demonstrated their stereoscopic chest film cassette changers, featuring a graduated speed of movement. The first and last portions of the movement are slow, with greater speed in the mid portion.

FRANKLIN X-RAY CORPORATION (Philadelphia, Penna.): A floor-to-ceiling mounted headstand was shown which permits accurate alignment of tube and patient through all phases of skull-sinus-mastoid radiography. Unique features are a removable grid Bucky, permitting positioning of the patient from behind the Bucky diaphragm, and a mobile platform chair for further ease in positioning of the patient. Also shown was a floor-wall-mounted vertical Bucky stand, which accommodates the reciprocating Bucky diaphragm. Due to rugged construction and a new type bearing suspension, there is no vibration in the Bucky, even when the grid is reciprocating.

GENERAL ELECTRIC COMPANY (Milwaukee, Wis.) displayed the Imperial, their newest diagnostic x-ray table. A large portion of their exhibit was given over to supply lines, such as illuminators, space savers, infant positioners, and pass boxes. Many of these items were new to the x-ray scene or vastly improved variations of old items. Also displayed were various modern Coolidge x-ray tubes, manufactured by and used in G.E. equipment. Featured was a new rotating-anode tube and a 3-million-volt sealed-off therapy tube.

GRUNE & STRATTON, INC. (New York, N. Y.): The outstanding feature of the Grune and Stratton display was the monumental Case-Shinz *Roentgen-Diagnostics*, of which the fourth and final volume will be ready shortly. Also of interest to the attending physicians were Zdansky's *Roentgen Diagnosis of the Heart and Great Vessels* (translated by Linn J. Boyd, M.D.), Casagrande and Frost's *Fundamentals of Clinical Orthopedics*, Snapper, Turner, and Moscovitz's *Multiple Myeloma;* and Goldman's *Fundamentals of Clinical Cancer*.

HALSEY X-RAY PRODUCTS, INC. (Brooklyn, N. Y.) displayed a new double-intensity illuminator with instant starting lamps and new instant-grip film holder. This view box affords standard illumination for normal diagnosis and can instantly provide double-intensity illumination for denser radiographs. Also featured was the Halsey Rigidform Cassette in phototiming, regular bakelite, magnesium, and grid-front models. Other Halsey products, including safelights, cassette holders, developing hangers, storage and drying racks, apron and glove racks were on display.

PAUL B. HOEBER, INC. (New York, N. Y.): New and timely Hoeber-Harper books of special interest to radiologists included Levitt's *Handbook of Radiotherapy*, Coley and Higinbotham's *Tumors of Bone*, McLaren's *Diagnostic Radiology*, Samuel's *Clinical Radiology of the Ear, Nose and Throat*, and Homburger and Fishman's *Physiopathology of Cancer*. Volumes in the *Annals of Roentgenology* series were also to be seen.

KELEKET X-RAY CORPORATION (Covington, Ky.) displayed the Keleket tube-crane, a rotating chair for radiation therapy, and a device permitting 180 degrees rotation, with a conventional 250 kv.p. therapy unit. Featured was the latest Keleket radiographic table, embodying new principles of weight support and flexibility.

LEA & FEBIGER (Philadelphia, Penna.) showed Epstein and Davidoff's *Atlas of Skull Roentgenograms*, published in 1953, supplementing two earlier publications: Davidoff and Dyke's *The Normal Encephalogram* and Davidoff and Epstein's *The Abnormal Pneumoencephalogram*. The three books together provide an excellent selection of cases, giving many details valuable in differential diagnosis by pneumoencephalograms or plain roentgenograms. Other titles included *Roentgen, Radium, and Radioisotope Therapy* by Delario; *Gastrointestinal X-ray Diagnosis* by Ritvo and Shauffer; and *Chest X-ray Diagnosis* by Ritvo.

LIEBEL-FLARSHEIM CO. (Cincinnati, Ohio) showed illustrations of Bucky diaphragms, timing units, and other important accessories.

MACHLETT LABORATORIES, INC. (Springdale, Conn.) featured their extensive line of radiographic tubes, including one with an 0.3-mm. focal spot.

MALLINCKRODT CHEMICAL WORKS (St. Louis, Mo.) centered attention upon Urokon, 35 and 70 per cent, for pyelography and opacification of blood vessels.

F. MATTERN MANUFACTURING COMPANY (Chicago Ill.) displayed the Duotech 250 ma. control, which introduces a new concept of x-ray technology, with emphasis on simplicity. Exposures are made through a milliampere-second integrator, with the use of a reciprocating Bucky, the object being to reduce the possibility of error, with resulting savings in film cost and time, as well as to increase dependability of individual exposures.

MICRO X-RAY RECORDER, INC. (Chicago, Ill.) showed a single microfilming unit that will record x-rays, photographs, charts, electrocardiograms, case histories, etc., on a continuous 100-ft. roll of 35-mm. film. While used principally to reduce storage space for x-ray film and records at the ratio of 500 to 1, it is also of advantage for the preparation of teaching films. The camera is automatic and can be operated by almost anyone. A two-lens system records radiographs of various dimensions, charts, etc., and provision is made for penetrating

over-exposed films. Viewers, readers, projectors, index and filing cards also were shown.

NORTH AMERICAN PHILIPS, INC. (Mt. Vernon, N. Y.): A 90-90 degree tilt table, was shown by North American Philips, with a spot film device, to accommodate 8 × 10, 10 × 12, and 14 × 17-inch film cassettes. An x-ray generator and control featured a signal system for the instant detection of trouble spots in the circuits. It also provided for maximum loading of the focal spot chosen, with resulting minimum unsharpness due to movement and geometric distribution.

In Room 402, there was displayed a rotational unit for all methods of therapy, including conventional stationary field and rotational convergent beam in 200 kv.p. and 250 kv.p. constant potential. Philips' well known contact and cavity as well as Chaoul therapy unit was demonstrated. A movie illustrated the use of Philips' image intensification for cineradiography, featuring high resolution and low dose rate.

NUCLEAR INSTRUMENT & CHEMICAL CORPORATION (Chicago, Ill.) exhibited instruments and devices for the detection and measurement of radioactivity. Included among these were the Isotron, a mobile instrument for thyroid uptake studies or brain tumor diagnosis, scalers for the precise measurement of radioactivity, scintillation and Geiger counters, and portable survey instruments. A new film badge service for persons working with x-rays, radium, or radioactive isotopes was also presented. These film badges provide an accurate means of determining the radiation dosages accumulated by laboratory personnel in the course of their work, and provide a wider detection range than any other commercially available film badge.

ORTHO-PHARMACEUTICAL CORPORATION (Raritan, N. J.) featured Salpix contrast medium, which is a non-irritating combination of the blood extender polyvinylpyrrolidone, with sodium acetrizoate (65.8 per cent iodine per molecule). It is stable, nonantigenic, and possesses certain characteristics similar to human serum albumin. It is water-soluble and does not release free iodine. It permits adequate visualization of the uterus and tubes without producing pain and is absorbed rapidly, leaving no radiopaque residue. Neither the "interrupted fractional injection" technic nor the 24-hour post-injection film, commonly required with iodized oils, is necessary with Salpix.

PAKO CORPORATION (Minneapolis, Minn.): The excellent results which may be obtained with seventy seconds of processing in the Pako Model 80 Filmtanx were demonstrated by actual processing in a darkroom built into the Pako exhibit. A functional display illustrated the full line of Pako chemical handling equipment, featuring the Pakotemp for automatic solution temperature control, Pako Hydromixer for mixing, storing, and pumping chemicals, and Pako replenisher valves and tanks and circulation-filtration equipment.

PICKER X-RAY CORPORATION (White Plains, N. Y.), had on display their new ceiling tube mount and Constellation table. This combination provides a completely clear floor area, with the option of utilizing any of the four corners of the room for additional radiographic items, such as a wall-mounted Bucky stand, an angiographic stand, a cassette changer, etc.

The Picker cobalt 60 unit was also shown, as was a model illustrating the method by which the entire stand will provide rotation through 280 degrees. Other items of interest were the new Picker Vanguard, featuring motor-driven 360-degree rotation x-ray therapy; a special treatment stretcher, with both lateral and longitudinal adjustments; and such accessories as the Schwartz pelvimeter, the Bell-Zwanger Inclinometer, Gastriloid (a new radiopaque medium) and Picker Flexigard lead-rubber gloves.

RADIOLOGY (Detroit, Mich.), the official journal of the Radiological Society of North America, gave special attention to the forthcoming *Cumulative Index, No. 3*, covering *Radiology* for the years 1948-1952. This *Index* is scheduled for summer publication, and with the two preceding indexes, will furnish a complete guide to Volumes 1–59 (1923–1952), covering both original papers and abstracts of the literature.

STANDARD X-RAY COMPANY (Chicago, Ill.) showed their new Model "G-90-90" Table, which permits fluoroscopy and radiography throughout a range of 180 degrees of adjustment. A novel feature permits adjustment of the speed of tilt of the table to any angulation. A newly designed ceiling mounted tube crane, employing a principle entirely different from that formerly used, also was shown. Safety features, preventing any possible injury to equipment or patient, were explained and demonstrated.

The new vertical control panel shown not only is attractive, but incorporates various features permitting ease of operation and servicing.

TIMES FACSIMILE CORPORATION (New York, N. Y.) exhibited equipment which will transmit reproductions of x-ray films from an outlying hospital to the radiologist's office, for interpretation. These are reduced in size 50 per cent in transmission. This method speeds up and gives continuity to the service performed by the radiologist for an outlying institution. Field tests are continuing, and equipment will be available after September 1954.

TRACERLAB, INC. (Boston, Mass.): Currently available instruments for medical applications of radioisotopes were shown by Tracerlab. Featured was the combination of the P-20 M Scintillation Detector and SC-34 Ratemeter. Also shown were cobalt-60 seeds for applicators and the RA-1 Sr 90 Beta Applicator. The film badge service, for detection of radiation exposure, was explained.

U. S. RADIUM CORPORATION (New York, N. Y.) exhibited for the first time their new High Resolution Intensifying Screen. This screen is designed to meet the demand for greater detail in the radio-

graph, without excessive loss in speed. It is a detail screen, suitable for general radiography. High speed, general purpose, and ultra detail intensifying screens were also shown. Radelin now offers a complete line of x-ray screens: four types of intensifying, two types of fluoroscopic, and two types of photo-radiographic.

VICTOREEN INSTRUMENT COMPANY (Cleveland, Ohio) showed a new integrating ratemeter, with interchangeable probes, and a new mobile package unit for radioiodine uptake and excretion measurements. The former measures rate and total beam output at the skin. The latter affords a routinized procedure for rapid direct per cent reporting of thyroid uptake, urine excretion, and body dissemination of radioiodine. Also on display were new grenz ray, high-energy, and isotope assay chambers and an A.C. charger for the Victoreen r-meter, direct and indirect reading personal exposure dosimeters, new scintillation and ion chamber survey meters. A detailed catalogue of radiation measuring instruments and accessories was distributed.

WEBSTER PHOTOCRAFT (Ft. Lauderdale, Fla.) displayed their Master X-ray Vu-Graph, for projecting 10-inch square views of 14 × 17-inch films, miniature 2 3/4 × 4-inch films, 35 mm. films, and lantern slides. It weighs 34 lb. A carrying case is optional. Also shown was an *Atlas of Miniature Roentgenographs*, to be used in conjunction with *Principles of Roentgenological Interpretation*, by L. R. Sante, M.D. The Atlas consists of 30 sets of 50 slides each, cardboard bound for study or as a teaching aid. The sets may be purchased individually or as a complete unit.

WESTINGHOUSE ELECTRIC CORPORATION (Pittsburgh, Penna.) exhibited a complete line of radiographic equipment, including a 180-degree tilt fluoroscopic table, with power assist for the fluoroscopic screen assembly, centered beam and pendulum therapy units, laminagraphic apparatus, and accessories. A feature of the exhibit was the television demonstration of examinations by means of the Fluorex, an image amplifier for fluoroscopy and cineradiography.

WILMOT CASTLE COMPANY (Rochester, N. Y.) demonstrated the new Castle Pelvic Anchor Sacral Rest, a means to precision radiography. By stabilizing related positions of the bony pelvis, x-ray beam and cassette, film images are made with exact uniformity. Subsequent films are automatically identical, as the central beam is always centered to pass directly through the unit's perineal and iliac posts. The expense of wasted film is thus eliminated. As shown, specially prepared post material acted to filter rays, increasing hip density to that of the pelvis. No areas were "burned out."

Available on both child and adult units, a new lateral cassette holder remains in the sterile field during surgery, and is aligned to present the cassette at a 90-degree angle to the beam.

WINTHROP-STEARNS, INC. (New York, N. Y.) featured Telepaque for use in gallbladder visualization. It is said to produce a higher percentage of excellent visualization and greater opacification in equivalent or smaller dosage than other oral media, with elimination of repeat tests, satisfactory visualization in many cases in which other media fail, delineation of the extrahepatic bile ducts (even with customary doses in many cases), a high proportion of symptom-free patients, rapid and adequate emptying of the gallbladder, rapid completion of the gallbladder series, and a uniformity of gallbladder visualization.

WOLF X-RAY PRODUCTS, INC. (Brooklyn, N. Y.) exhibited a complete line of radiographic accessories, including view boxes, cassettes, lead gloves, and lead aprons.

YEAR BOOK PUBLISHERS (Chicago, Ill.): The new *Planning Guide for Radiologic Installations*, issued under the auspices of The American College of Radiology, was outstanding in the Year Book Publishers' display. This important volume gives all known "do's and don'ts" concerning the planning and installation of x-ray equipment, from the smallest office to the most elaborate department. Other best-selling volumes in the exhibit were the new *Year Book of Radiology*, a new edition of Rigler's *Roentgen Diagnosis of the Chest*, Hodges, Lampe, and Holt's *Radiology for Medical Students*, and Requarth's *Diagnosis of Acute Abdominal Pain*.

T. J. WACHOWSKI, M.D., *Chairman*
Commercial Exhibits Committee

ANNOUNCEMENTS AND BOOK REVIEWS

RADIATION RESEARCH SOCIETY

The annual meeting of the Radiation Research Society will be held at Cleveland, Ohio, on May 17–19, 1954, at the Wade Park Manor Hotel and at Western Reserve University. In addition to submitted papers, a symposium on "The Role of Nuclear Damage in Radiation Induced Cell Injury and Death" will be held and several papers on radiation physics and chemistry will be presented by invitation. Those interested in reporting original research in radiation effects or desiring additional information should address the Secretary of the Society, Dr. A. Edelmann, Brookhaven National Laboratory, Upton, Long Island, New York.

CENTRAL OHIO RADIOLOGICAL SOCIETY

Recently elected officers of the Central Ohio Radiological Society are: President, Dr. Frank A. Riebel, Columbus; Vice-President, Dr. George F. Jones, Lancaster; Secretary-Treasurer, Dr. Howard W. Bangs, 1381 West Sixth Ave., Columbus 12. Dr. Ralph W. Holmes of Chillicothe was renamed Councilor to the American College of Radiology.

COURSE IN ESSENTIAL PHYSICS OF RADIOTHERAPY AND CLINICAL APPLICATIONS OF ISOTOPES

The University of Southern California Medical Extension Education is presenting a course, "The Essential Physics of Therapeutic Radiology and the Clinical Applications of Radioactive Isotopes" by Robert E. Pugh, Jr., Physicist in Radiology; Paul C. Aebersold, Ph.D., Director, Isotopes Division, United States Atomic Energy Commission, Oak Ridge, Tennessee; and Henry L. Jaffe, M.D., Associate Clinical Professor of Therapeutic Radiology. This course is to be given March 8 through May 24, 1954, on Monday evenings from 8:00 to 10:00 P.M., at the Los Angeles County Hospital and the Cedars of Lebanon Hospital, Los Angeles. It will provide excellent background information for those who wish also to obtain the actual clinical training necessary for A. E. C. certification.

Inquiries for further information should be addressed to Robert S. Cleland, M.D., Assistant Director, Medical Extension Education, University of Southern California School of Medicine, 2025 Zonal Ave., Los Angeles 33, Calif.

Books Received

Books received are acknowledged under this heading, and such notice may be regarded as recognition of the courtesy of the sender. Reviews will be published in the interest of our readers and as space permits.

ANNUAL REVIEW OF NUCLEAR SCIENCE. Editor, JAMES G. BECKERLEY, United States Atomic Energy Commission. Associate Editors, MARTIN D. KAMEN, Washington University Medical School, DONALD F. MASTICK, United States Atomic Energy Commission, LEONARD I. SCHIFF, Stanford University. Volume 3, with 412 pages and numerous tables and figures. Published by Annual Reviews, Inc., Stanford, Calif., in cooperation with the National Research Council of the National Academy of Sciences, 1953. Price $7.00.

DIAGNOSIS AND LOCALIZATION OF BRAIN TUMORS. A CLINICAL AND EXPERIMENTAL STUDY EMPLOYING FLUORESCENT AND RADIOACTIVE TRACER METHODS. By GEORGE E. MOORE, M.D., Ph.D., Markle Scholar in Medical Science; Director, Roswell Park Memorial Institute; Associate Professor, Department of Surgery, Buffalo University School of Medicine; Formerly, Associate Professor, Department of Surgery, University of Minnesota, The Medical School, Minneapolis, Minn. A volume of 217 pages, with 66 figures. Published by Charles C Thomas, Springfield, Ill., 1953. Price $10.50.

THE CHEST. A HANDBOOK OF ROENTGEN DIAGNOSIS. By LEO G. RIGLER, M.D., Professor and Chief, Department of Radiology, University of Minnesota. A volume of 380 pages with 338 illustrations. Published by The Yearbook Publishers, Inc., Chicago, Ill., Second edition, 1954. Price $8.00.

L'ÉTUDE RADIOLOGIQUE DES VOIES SÉMINALES, NORMALES ET PATHOLOGIQUES. By JACQUES BOREAU, Chirurgien Assistant des Hôpitaux de Paris. Préface by DR. LOUIS MICHON. A monograph of 130 pages, with 127 illustrations. Published by Masson & Cie, 120, Boulevard Saint-Germain, Paris (VI^e). Price 1.250 fr.

RADIOLOGICAL SOCIETIES: SECRETARIES AND MEETING DATES

Editor's Note: Secretaries of state and local radiological societies are requested to co-operate in keeping this section up-to-date by notifying the editor promptly of changes in officers and meeting dates.

RADIOLOGICAL SOCIETY OF NORTH AMERICA. *Secretary-Treasurer*, Donald S. Childs, M.D., 713 E. Genesee St., Syracuse 2, N. Y.

AMERICAN RADIUM SOCIETY. *Secretary*, Robert E. Fricke, M.D., Mayo Clinic, Rochester, Minn.

AMERICAN ROENTGEN RAY SOCIETY. *Secretary*, Barton R. Young, M.D., Germantown Hospital, Philadelphia 44, Penna.

AMERICAN COLLEGE OF RADIOLOGY. *Exec. Secretary*, William C. Stronach, 20 N. Wacker Dr., Chicago 6.

SECTION ON RADIOLOGY, A. M. A. *Secretary*, Paul C. Hodges, M.D., 950 East 59th St., Chicago 37.

Alabama

ALABAMA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, J. A. Meadows, Jr., M.D., Medical Arts Bldg., Birmingham 5.

Arizona

ARIZONA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, R. Lee Foster, M.D., 507 Professional Bldg., Phoenix. Annual meeting with State Medical Association; interim meeting in December.

Arkansas

ARKANSAS RADIOLOGICAL SOCIETY. *Secretary*, Fred Hames, M.D., Pine Bluff. Meets every three months and at meeting of State Medical Society.

California

CALIFORNIA MEDICAL ASSOCIATION, SECTION ON RADIOLOGY. *Secretary*, H. R. Morris, M.D., 1027 D St., San Bernardino.

EAST BAY ROENTGEN SOCIETY. *Secretary*, Dan Tucker, M.D., 434 30th St., Oakland 9. Meets monthly, first Thursday, at Peralta Hospital.

LOS ANGELES RADIOLOGICAL SOCIETY. *Secretary*, George Jacobson, M.D., 1200 North State St., Los Angeles 33. Meets monthly, second Wednesday, Los Angeles County Medical Association Bldg.

NORTHERN CALIFORNIA RADIOLOGICAL CLUB. *Secretary*, H. B. Stewart, Jr., M.D., 2920 Capitol Ave., Sacramento. Meets last Monday of each month, September to May.

PACIFIC ROENTGEN SOCIETY. *Secretary*, L. Henry Garland, M.D., 450 Sutter St., San Francisco 8. Meets annually at time of California State Medical Association convention.

RADIOLOGICAL SOCIETY OF SOUTHERN CALIFORNIA. *Secretary-Treasurer*, Donald R. Laing, M.D., 65 North Madison Ave., Pasadena 1.

SAN DIEGO RADIOLOGICAL SOCIETY. *Secretary*, C. W. Bruner, M.D., 2456 Fourth Ave., San Diego 1. Meets first Wednesday of each month.

SAN FRANCISCO RADIOLOGICAL SOCIETY. *Secretary*, I. J. Miller, M.D., 2680 Ocean Ave., San Francisco 27. Meets quarterly, at the University Club.

SOUTH BAY RADIOLOGICAL SOCIETY. *Secretary*, James J. McCort, M.D., Santa Clara County Hospital, San Jose-Los Gatos Road, San Jose. Meets monthly, second Wednesday.

X-RAY STUDY CLUB OF SAN FRANCISCO. *Secretary*, Wm. W. Saunders, M.D., VA Hospital, San Francisco 21. Meets third Thursday at 7:45, Lane Hall, Stanford University Hospital.

Colorado

COLORADO RADIOLOGICAL SOCIETY. *Secretary*, Parker Allen, M.D., Children's Hospital, Denver. Meets monthly, third Friday, at University of Colorado Medical Center or Denver Athletic Club.

Connecticut

CONNECTICUT STATE MEDICAL SOCIETY, SECTION ON RADIOLOGY. *Secretary-Treasurer*, William A. Goodrich, M.D., 85 Jefferson St., Hartford 14. Meets bimonthly, second Wednesday.

CONNECTICUT VALLEY RADIOLOGICAL SOCIETY. *Secretary*, B. Bruce Alicandri, M.D., 20 Maple St., Springfield, Mass. Meets second Friday of October and April.

District of Columbia

RADIOLOGICAL SECTION, DISTRICT OF COLUMBIA MEDICAL SOCIETY. *Secretary*, Alvin C. Wyman, M.D., 5445 28th St., N.W., Washington. Meets third Wednesday, January, March, May, and October, at 8:00 P.M., in Medical Society Library.

Florida

FLORIDA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Hugh G. Reaves, M.D., Medical Arts Bldg., Sarasota. Meets in April and in October.

GREATER MIAMI RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Richard D. Shapiro, M.D., 541 Lincoln Road, Miami Beach. Meets monthly, third Wednesday, 8:00 P.M.

Georgia

ATLANTA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Albert A. Rayle, Jr., M.D., 490 Peachtree St. Meets second Friday, September to May.

GEORGIA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Robert M. Tankesley, M.D., 218 Doctors Bldg., Atlanta. Meets in November and at the annual meeting of the State Medical Association.

RICHMOND COUNTY RADIOLOGICAL SOCIETY. *Secretary*, Wm. F. Hamilton, Jr., M.D., University Hospital, Augusta. Meets first Thursday of each month.

Hawaii

RADIOLOGICAL SOCIETY OF HAWAII. *Secretary*, Philip S. Arthur, M.D., Suite 42, Young Hotel Bldg., Honolulu. Meets third Friday of each month.

Illinois

CHICAGO ROENTGEN SOCIETY. *Secretary*, Elbert K. Lewis, M.D., 6337 S. Harvard Ave., Chicago 21. Meets at the University Club, second Thursday of October, November, January, February, March, and April at 8:00 P.M.

ILLINOIS RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Stephen L. Casper, M.D., Physicians and Surgeons Clinic, Quincy.

ILLINOIS STATE MEDICAL SOCIETY, SECTION ON RADIOLOGY. *Secretary*, George E. Irwin, Jr., M.D., 427 N. Main St., Bloomington.

Indiana

INDIANA ROENTGEN SOCIETY. *Secretary-Treasurer*, John A. Robb, M.D., 23 East Ohio St., Indianapolis. Annual meeting in May.

Iowa

IOWA RADIOLOGICAL SOCIETY. *Secretary*, James T. McMillan, M.D., 1104 Bankers Trust Bldg., Des Moines. Meets during annual session of State Medical Society, and holds a scientific session in the Fall.

Kansas

KANSAS RADIOLOGICAL SOCIETY. *Secretary*, Willis L. Beller, M.D., 700 Kansas Ave., Topeka. Meets in the Spring with the State Medical Society and in the Winter on call.

Kentucky

KENTUCKY RADIOLOGICAL SOCIETY. *Secretary*, Everett L. Pirkey, M.D., Louisville General Hospital. Meets monthly, second Friday, at Seelbach Hotel, Louisville.

Louisiana

ORLEANS PARISH RADIOLOGICAL SOCIETY. *Secretary*, Joseph V. Schlosser, M.D., Charity Hospital of Louisiana, New Orleans 13. Meets second Tuesday of each month.

RADIOLOGICAL SOCIETY OF LOUISIANA. *Secretary-Treasurer*, J. T. Brierre, M.D., 700 Audubon Bldg., New Orleans.

SHREVEPORT RADIOLOGICAL CLUB. *Secretary*, W. R. Harwell, M.D., 608 Travis St. Meets monthly September to May, third Wednesday.

Maine

MAINE RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Jack Spencer, M.D., Maine General Hospital, Portland 4. Meets three times a year—Spring, Summer, and Fall.

Maryland

BALTIMORE CITY MEDICAL SOCIETY, RADIOLOGICAL SECTION. *Secretary-Treasurer*, H. Leonard Warres, M.D., 2337 Eutaw Place, Baltimore 17. Meets third Tuesday, September to May.

MARYLAND RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, H. Leonard Warres, M.D., 2337 Eutaw Place, Baltimore 17.

Michigan

DETROIT X-RAY AND RADIUM SOCIETY. *Secretary*, E. F. Lang, M.D., Harper Hospital, Detroit 1. Meets first Thursday, October to May, at Wayne County Medical Society club rooms.

Minnesota

MINNESOTA RADIOLOGICAL SOCIETY. *Secretary*, John R. Hodgson, M.D., The Mayo Clinic, Rochester. Meets in Spring and Fall.

Mississippi

MISSISSIPPI RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, John W. Evans, M.D., 117 N. President St., Jackson, Miss. Meets monthly, third Tuesday, at 6:30 P.M., at the Rotisserie Restaurant, Jackson.

Missouri

RADIOLOGICAL SOCIETY OF GREATER KANSAS CITY. *Secretary*, James E. McConchie, M.D., First National Bank Bldg., Independence, Mo. Meets last Friday of each month.

ST. LOUIS SOCIETY OF RADIOLOGISTS. *Secretary*, Francis O. Trotter, Jr., M.D., 634 North Grand Blvd. Meets on fourth Wednesday, October to May.

Montana

MONTANA RADIOLOGICAL SOCIETY. *Secretary*, Grant P. Raitt, M.D., 413 Medical Arts Bldg., Billings. Meets annually.

Nebraska

NEBRASKA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, James F. Kelly, Jr., M.D., 816 Medical Arts Bldg., Omaha. Meets third Wednesday of each month at 6 P.M. in Omaha or Lincoln.

New England

NEW ENGLAND ROENTGEN RAY SOCIETY. *Secretary*, Stanley M. Wyman, M.D., Massachusetts General Hospital, Boston 14. Meets monthly on third Friday, at the Harvard Club, Boston.

New Hampshire

NEW HAMPSHIRE ROENTGEN SOCIETY. *Secretary*, Albert C. Johnston, M.D., 127 Washington St., Keene.

New Jersey

RADIOLOGICAL SOCIETY OF NEW JERSEY. *Secretary*, Salomon Silvera, M.D., 921 Bergen Ave., Jersey City. Meets at Atlantic City at time of State Medical Society and midwinter in Elizabeth.

New York

BUFFALO RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Mario C. Gian, M.D., 610 Niagara St., Buffalo 1. Meets second Monday, October to May.

CENTRAL NEW YORK ROENTGEN SOCIETY. *Secretary*, Dwight V. Needham, M.D., 608 E. Genesee St., Syracuse 2. Meets in January, May, and October.

KINGS COUNTY RADIOLOGICAL SOCIETY. *Secretary*, Solomon Maranov, M.D., 1450 51st St., Brooklyn 19. Meets fourth Thursday, October to April (except December), at 9:00 P.M., Kings County Medical Bldg.

NASSAU RADIOLOGICAL SOCIETY. *Secretary*, Frank Huber, M.D., 131 Fulton Ave., Hempstead, N. Y. Meets second Tuesday, February, April, June, October, and December.

NEW YORK ROENTGEN SOCIETY. *Secretary*, Jacob R. Freid, M.D., 1049 Park Ave., New York.

NORTHEASTERN NEW YORK RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Donald H. Baxter, M.D., Albany Hospital, Albany. Meets in the capital area second Wednesday, October, November, March, and April. Annual meeting in May or June.

RADIOLOGICAL SOCIETY OF NEW YORK STATE. *Secretary-Treasurer*, Mario C. Gian, M.D., 610 Niagara St., Buffalo. Meets annually with the State Medical Society.

ROCHESTER ROENTGEN-RAY SOCIETY. *Secretary-Treasurer*, A. Gordon Ide, M.D., 277 Alexander St. Meets at Strong Memorial Hospital, 8:15 P.M., last Monday of each month, September through May.

WESTCHESTER RADIOLOGICAL SOCIETY. *Secretary*, Charles G. Huntington, M.D., 170 Maple Ave., White Plains, N.Y. Meets third Tuesday of January and October and at other times as announced.

North Carolina

RADIOLOGICAL SOCIETY OF NORTH CAROLINA. *Secretary*, Waldemar C. A. Sternbergh, M.D., 1400 Scott Ave., Charlotte 2. Meets in April and October.

North Dakota

NORTH DAKOTA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, H. Milton Berg, M.D., Quain & Ramstad Clinic, Bismarck. Meets in the Spring with State Medical Association; in Fall or Winter on call.

Ohio

OHIO STATE RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, M. M. Thompson, Jr., M.D., 316 Michigan St., Toledo.

CENTRAL OHIO RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Howard W. Bangs, 1381 West Sixth Ave., Columbus 12. Meets second Thursday, October, December, February, April, and June, 6:30 P.M., Columbus Athletic Club, Columbus.

CLEVELAND RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Mortimer Lubert, M.D., Heights Medical Center Bldg., Cleveland Heights 6. Meets at 6:45 P.M. on fourth Monday, October to April, inclusive.

GREATER CINCINNATI RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Chapin Hawley, M.D., 927 Carew Tower, Cincinnati 2. Meets first Monday of each month, September to June, at Cincinnati General Hospital.

MIAMI VALLEY RADIOLOGICAL SOCIETY. *Secretary*, W. S. Koller, M.D., 60 Wyoming St., Dayton. Meets monthly, second Friday.

Oklahoma

OKLAHOMA STATE RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, John R. Danstrom, M.D., Medical Arts Bldg., Oklahoma City.

Oregon

OREGON RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, John Wayne Loomis, M.D., 919 Taylor Street Bldg., Portland 5. Meets monthly, second Wednesday, October to June, at 8:00 P.M., University Club, Portland.

Pacific Northwest

PACIFIC NORTHWEST RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Sydney J. Hawley, M.D., 1320 Madison St., Seattle 4. Meets annually in May.

Pennsylvania

PENNSYLVANIA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, James M. Converse, M.D., 416 Pine St., Williamsport 8. Meets annually.

PHILADELPHIA ROENTGEN RAY SOCIETY. *Secretary*, Herbert M. Stauffer, M.D., Temple University Hospital, Philadelphia 40. Meets first Thursday of each month at 5:00 P.M., from October to May, in Thompson Hall, College of Physicians.

PITTSBURGH ROENTGEN SOCIETY. *Secretary-Treasurer*, Donald H. Rice, M.D., 4800 Friendship Ave., Pittsburgh 24. Meets monthly, second Wednesday, at 6:30 P.M., October to May, at Webster Hall.

Rocky Mountain States

ROCKY MOUNTAIN RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, John H. Freed, M.D., 4200 East Ninth Ave., Denver 7, Colo.

South Carolina

SOUTH CAROLINA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*. William A. Klauber, M.D., Self Memorial Hospital, Greenwood. Meets with State Medical Association in May.

South Dakota

RADIOLOGICAL SOCIETY OF SOUTH DAKOTA. *Secretary-Treasurer*, Donald J. Peik, M.D., 303 S. Minnesota Ave., Sioux Falls. Meets during annual meeting of State Medical Society.

Tennessee

MEMPHIS ROENTGEN CLUB. *Secretary*, Harvey Thompson, M.D., 899 Madison Ave. Meets first Monday of each month at John Gaston Hospital.

TENNESSEE RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, George K. Henshall, M.D., 311 Medical Arts Bldg., Chattanooga 3. Meets annually with State Medical Society in April.

Texas

DALLAS-FORT WORTH ROENTGEN STUDY CLUB. *Secretary*, Otto H. Grunow, M.D., 650 Fifth Ave., Fort Worth 4, Texas. Meets monthly, third Monday 6:30 P.M., at the Greater Fort Worth International Airport.

HOUSTON RADIOLOGICAL SOCIETY. *Secretary*, Harry Fishbein, M.D., 324 Medical Arts Bldg., Houston 2.

SAN ANTONIO-MILITARY RADIOLOGICAL SOCIETY. *Secretary*, Hugo F. Elmendorf, Jr., M.D., 730 Medical Arts Building, San Antonio 5, Texas. Meets at Brook Army Medical Center, the first Monday of each month.

TEXAS RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, R. P. O'Bannon, M.D., 650 Fifth Ave., Fort Worth. Next meeting Jan. 29–30, 1954, Dallas.

Utah

UTAH STATE RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Angus K. Wilson, M.D., 343 S. Main St., Salt Lake City 1. Meets third Wednesday, January, March, May, September, November.

Virginia

VIRGINIA RADIOLOGICAL SOCIETY. *Secretary*, P. B. Parsons, M.D., 1308 Manteo St., Norfolk 7.

Washington

WASHINGTON STATE RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Eva L. Gilbertson, M.D., 1317 Marion St., Seattle 4. Meets fourth Monday, September through May, at 610 Pine St., Seattle.

West Virginia

WEST VIRGINIA RADIOLOGICAL SOCIETY. *Secretary*, W. Paul Elkin, 515–519, Medical Arts Bldg., Charleston. Meets concurrently with annual meeting of State Medical Society, and at other times as arranged by Program Committee.

Wisconsin

MILWAUKEE ROENTGEN RAY SOCIETY. *Secretary-Treasurer*, Jerome L. Marks, M.D., 161 W. Wisconsin Ave., Milwaukee 1. Meets monthly on fourth Monday at the University Club.

SECTION ON RADIOLOGY, STATE MEDICAL SOCIETY OF WISCONSIN. *Secretary*, Abraham Melamed, M.D., 425 E. Wisconsin Ave., Milwaukee 2. Meets in October with State Medical Society.

UNIVERSITY OF WISCONSIN RADIOLOGICAL CONFERENCE. Meets first and third Thursday at 4 P.M., September to May, Service Memorial Institute.

WISCONSIN RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, W. W. Moir, M.D., Sheboygan Memorial Hospital, Sheboygan.

Puerto Rico

ASOCIACIÓN PUERTORRIQUEÑA DE RADIOLOGÍA. *Secretary*, Rafael A. Blanes, M.D., Box 9724 Santurce, Puerto Rico.

CANADA

CANADIAN ASSOCIATION OF RADIOLOGISTS. *Honorary Secretary-Treasurer*, D. L. McRae, M.D. Asso-Hon. Secretary-Treasurer, Guillaume Gill, M.D. *Central Office*, 1555 Summerhill Ave., Montreal 25, Quebec. Meets in January and June.

LA SOCIÉTÉ CANADIENNE-FRANÇAISE D'ELECTROLOGIE ET DE RADIOLOGIE MÉDICALES. *General Secretary*, Origène Dufresne, M.D., Institut du Radium, Montreal. Meets third Saturday of each month.

CUBA

SOCIEDAD DE RADIOLOGÍA Y FISIOTERAPÍA DE CUBA. Secretary, Dr. Rafael Gómez Zaldívar. Offices in Hospital Mercedes, Havana. Meets monthly.

MEXICO

SOCIEDAD MEXICANA DE RADIOLOGÍA Y FISIOTERAPÍA. *General Secretary*, Dr. Dionisio Pérez Cosio, Marsella 11, Mexico, D.F. Meets first Monday of each month.

PANAMA

SOCIEDAD RADIOLÓGICA PANAMEÑA. *Secretary-Editor*, Luis Arrieta Sánchez, M.D., Apartado No. 86, Panama, R. de P.

ABSTRACTS OF CURRENT LITERATURE

ROENTGEN DIAGNOSIS

The Head and Neck

SHELDON, P. W. E., ET AL. Pneumo-encephalography, with Special Reference to the Demonstration of the Basal Cisterns 281

SCIARRA, DANIEL, AND SPROFKIN, BERTRAM E. Symptoms and Signs Referable to the Basal Ganglia in Brain Tumor 281

OLSSON, OLLE. Vertebral Angiography in the Diagnosis of Acoustic Nerve Tumors 281

SMITH, CHARLES D., AND WEAVER, EDGAR N. Lipoma of the Corpus Callosum 282

GARSCHE, R. Intracranial Calcification as a Late Result of Tuberculous Meningitis Following Treatment by Streptomycin 282

RITCHIE, WALLACE P., AND HAINES, GERALD. Spontaneous Intracranial Hemorrhage in Children. Eight Cases 282

PIA, H.-W. The Healing Aspects of Skull Fractures in Children 282

HAAS, LEWIS L. Osteitis of the Sphenoid Sinus 283

PENMAN, JOHN. Some Developments in the Technique of Trigeminal Injection 283

The Chest

SCHMID, PAUL CH. Technic of Bronchography in Children 284

DI RIENZO, S. Roentgenology of the Operated Lung 284

RANSDELL, HERBERT T., JR., AND ELLISON, ROBERT G. Volvulus of a Lobe of the Lung as a Complication of Diaphragmatic Hernia. 284

PUCKETT, THOMAS F. Pulmonary Histoplasmosis. Twenty-two Cases with Identification of H. capsulatum in Resected Lesions 285

STEIN, HANS F. Coexisting Pulmonary Coccidioidomycosis and Tuberculosis 285

SALYER, JOHN M., ET AL. Pulmonary Hematoma 285

SANTY, PAUL, ET AL. Bronchial and Pulmonary Hamartochondromas 286

TOBIN, JOHN R., JR., AND WILDER, THOMAS C. Pulmonary Arteriovenous Fistula Associated with Hereditary Hemorrhagic Telangiectasis, in Father and Son 286

BENOIT, HECTOR W., JR., AND ACKERMAN, LAUREN V. Solitary Pleural Mesotheliomas. 286

DAZZI, CARLO. Tonsillar Hypertrophy and Mediastinal-Hilar Adenopathy 287

SILVERMAN, JACOB J., ET AL. Mediastinal Emphysema Following Tonsillectomy 287

ELKELES, A. Parathyroid Tumour with Hyperparathyroidism and Coexistent Gastric and Duodenal Ulceration 287

EDLING, NILS P. G. The Radiologic Appearances of the Heart, Oesophagus, and Lungs in Funnel Chest Deformity 288

GOWEN, G. HOWARD. Detection of Cardiac Abnormalities by Mass Chest X-Ray Surveys 288

GASUL, BENJAMIN M., ET AL. Angiocardiography in Congenital Heart Disease Correlated with Clinical and Autopsy Findings, Thirty-Four Cases in Infants and Young Children 288

ROBBINS, LAURENCE L., AND WYMAN, STANLEY M. Coarctation of the Thoracic Aorta. Signs Demonstrable by Conventional Roentgenography 289

BESTERMAN, E. M. M., AND THOMAS, G. T. Radiological Diagnosis of Rheumatic Pericardial Effusion 289

CAMPBELL, MAURICE, AND KAUNTZE, RALPH. Congenital Aortic Valvular Stenosis 290

LEWIS, CECIL, AND ROGERS, LAMBERT. The Cervical Aortic Knuckle Which Resembles an Aneurysm 290

HEDMAN, CHRISTIAN, ET AL. Caval Reflexes in Angiocardiography and the Dynamics of the Right Atrium 290

PATTINSON, J. N. Anomalous Right Subclavian Artery 290

The Digestive System

HAUBRICH, R. Esophageal Ulcer with Severe Kyphoscoliosis 291

OCHSNER, A., AND BLALOCK, J. Carcinoma of the Stomach. Necessity for Re-evaluation of Therapeutic Philosophy 291

SKORNECK, ALAN B. Pseudodiverticular Sarcoma of the Stomach 291

COLP, RALPH, AND WEINSTEIN, VERNON A. Benign Tumors of the Stomach 292

MARSHALL, DANIEL. Giant Rugae with Normal Overlying Mucosa Simulating Gastric Neoplasm 292

MELAMED, ABRAHAM, ET AL. Prolapse of Gastric Mucosa: 150 Cases 292

GRANONE, F. Duodenal Herniation of the Gastric Mucosa 293

MACPHEE, IAN W. Disorders of Motility of the Small Bowel 293

DAVISON, GEORGE, AND HARLAN, T. R. Intestinal Obstruction in the Neonatal Period 293

ROWE, ALBERT H., ET AL. Regional Enteritis—Its Allergic Aspects 293

YATES, CHARLES W. Double Contrast Studies of the Colon: Polyps in Children 294

PARSONS, PHILIP B. Paraduodenal Hernias 294

ROTHENBERG, ROBERT E. Cholecystectomy and Its Relation to the Stomach and Duodenum. 75 Cases with Preoperative and Postoperative X-Ray Studies 294

LOOSE, K. E. Operative and Postoperative Cholangiography by Serial Films 295

MILLER, CLARK F., AND CARRIER, JOHN W. Use of Telepaque in Cholecystography. A Comparative Study 295
DOUBILET, HENRY, ET AL. Diagnosis of Biliary-Pancreatic Cancer 295
CALDERIN GOMEZ, ALBERTO. A Case of True Pancreatic Cyst in Early Infancy 296

The Musculoskeletal System

PELTIER, LEONARD F. Impact of Röntgen's Discovery upon Treatment of Fractures 296
ENGESET, ARNE, ET AL. Significance of Growth in the Roentgenological Skeletal Changes in Early Congenital Syphilis 296
GOLDENBERG, RAPHAEL R. Diagnostic Problems in Herniated Intervertebral Disc 296
MYERS, ABRAHAM. Degeneration of Cervical Intervertebral Discs Following Whip-Lash Injury 297
TAYLOR, A. R. Mechanism and Treatment of Spinal-Cord Disorders Associated with Cervical Spondylosis 297
BREMNER, A. E., AND NELIGAN, G. A. Benign Form of Acute Osteitis of Spine in Young Children 297
HAMSA, W. R., AND CAMPBELL, L. S. Giant-Cell Tumor of the Spine: Two Cases 298
BAKER, HARVEY W., AND COLEY, BRADLEY L. Chordoma of Lumbar Vertebra 298
CHIAPPA, SERGIO, AND SACCHI, ADOLFO. A Rare Manifestation of Vertebral Angioma 298
SENNETT, EDWARD J. Chordoma: Its Roentgen Diagnostic Aspects and Its Response to Roentgen Therapy 299
OSMOND, JOHN D., JR. Lesions Producing Bursitis-like Symptoms. Importance of Radiographic Study Before Treatment of Bursitis 299
NEVIASER, JULIUS S. Common Injuries of the Musculotendinous Cuff of the Shoulder 299
WIRZ, F. Osteoporosis as an Early Symptom of Osteochondrosis Deformans Coxae Juvenilis 299
LAAGE, HERBERT, ET AL. Horizontal Lateral Roentgenography of the Hip in Children 300
DUNLAP, KNOX, ET AL. A New Method for Determination of Torsion of the Femur 300
RYDER, CHARLES T., AND CRANE, LAWRENCE. Measuring Femoral Anteversion: Problem and Method 300
BERSACK, SOLOMON R., AND RIZZOLI, HUGO V. Malignant Sympathetic Neuroectodermal Tumor 300

Gynecology and Obstetrics

SHEARES, B. H. The Helicoid Uterus 301
WHITEHEAD, A. S. Determination of Placental Site by Soft-Tissue Radiography 301
CURRY, ROBERT W. A Simple Method of Roentgen Pelvimetry 302
JACOBS, J. BAY. Value of the Lateral Pelvic Roentgenogram as an Index of Fetal Maturity and Type of Maternal Pelvis 302
CRICHTON, DERK. Intra-Uterine Growth of Foetal Head After 36th Week of Pregnancy 302

The Genitourinary System

MORALES, OLALLO, AND ROMANUS, RAGNAR. Urethrography in the Male with a Highly Viscous, Water-Soluble Contrast Medium, Umbradil-Viscous U 303
SANDSTRÖM, CARL. Contrast Media for the Kidneys, Heart and Vessels, and Their Toxicity 303
GILG, EJNAR. Influence of Diphenhydramine (Benadryl) on the Side-Effects of Diodone in Urography 303
WILSON, HUGH M. Roentgenological Aspects of Renal Function 304
KÖHLER, ROLF. Investigations on Backflow in Retrograde Pyelography. A Roentgenological and Chemical Study 304
TINCKLER, LAURENCE F. Presacral Perirenal Pneumography 304
DEARING, RUTH. A Study of the Renal Tract in Carcinoma of the Cervix 305
STEINBACH, HOWARD L., AND BROWN, RAYNOLD F. Retroperitoneal Tumors in Children 305
BRIGGS, JOHN D., AND NEALE, RODERICK M. Renocolic Fistula 305

The Blood Vessels

BOYCE, WILLIAM H., ET AL. A New Technique of Venography of Lower Extremities with Urokon 306
PEIRCE, E. CONVERSE, 2ND, AND RAMEY, WILLIAM P. Renal Arteriography. Report of a Percutaneous Method Using the Femoral Approach and a Disposable Catheter 306
BAHNSON, HENRY T., ET AL. Splenic-Portal Venography. A Technique Utilizing Percutaneous Injection of Radiopaque Material into the Spleen 306
BONSE, G., AND KARG, R. X-Ray Findings in Kaposi's Angiomatosis 307

RADIOTHERAPY

PATERSON, EDITH, AND FARR, R. F. Cerebellar Medulloblastoma: Treatment by Irradiation of Whole Central Nervous System 307
KAAE, SIGVARD. Radiotherapy in Cancer of the Breast, with Particular Reference to Value of Preoperative Irradiation. Analysis of 1418 New Cases 307
RAWSON, ARNOLD J., AND FRANK, JOE L., JR. Treatment by Irradiation of Lymphangiosarcoma in Postmastectomy Lymphedema 308
BINKLEY, FREDERICK M., ET AL. Mediastinal Tumors of Thymic Origin 308
CHARDACK, WILLIAM M., AND MACCALLUM, JAMES D. Pancoast Syndrome Due to Bronchiogenic Carcinoma: Successful Removal and Postoperative Irradiation 308

JAVERT, CARL T., AND RASCOE, ROBERT R. Serous Cystadenocarcinoma of the Ovary: 127 Cases. 309
WINSBURY-WHITE, H. P. Treatment of Carcinoma of the Bladder 309
WANG, C. C., AND SCHULZ, MILFORD D. Ewing's Sarcoma. A Study of Fifty Cases 309
BLOMFIELD, G. W. Experience with Two Million Volt X-Ray Therapy and a Preliminary Assessment of Clinical Results 310
TRUMP, JOHN G., ET AL. High Energy Electrons for the Treatment of Extensive Superficial Malignant Lesions 310
FLETCHER, GILBERT H. Treatment of Oral Cavity Cancers. Present Status of Radiotherapy 311
COLE, A., ET AL. A Simplified Automatic Isodose Recorder 311

RADIOISOTOPES

POCHIN, E. E., ET AL. Discussion on Use of Radioisotopes in Surgery 311
MAYNEORD, W. V., ET AL. Discussion on the Use of Isotopes in Neurology 312
BAUER, FRANZ K., ET AL. Jet Injection of Radioisotopes. A Clinical Study Comparing Needle and Jet Injection of I^{131}, K^{42}, and Na^{24} 313
STOKINGER HERBERT E. Size of Dose: Its Effect on Distribution in the Body 313
JOHANSSON, SVEN A. E., AND SKANSE, BENGT. A Photographic Method of Determining Distribution of Radioactive Material in Vivo 313
MACK, ROBERT E. Use of Radioactive Iodine in Diagnosis and Treatment of Hyperthyroidism 313
MORTON, M. E. Measurement of Thyroxin Synthesis with I^{131}. A Test for Evaluation of Thyroid Function in Equivocal States 314
WHITE, WILLIAM E. Rate of Formation of Nondiffusible (Organic) Fraction of I^{131} in Plasma Correlated with Apparent Thyroid State 314
HOFFMAN, M.C. Radioactive Iodine-Labeled Fat. 314
ANDREWS, GOULD A., ET AL. Metabolism and Distribution of Colloidal Au^{198} Injected into Serous Cavities for Treatment of Effusions Associated with Malignant Neoplasms 314
KNISELEY, RALPH M., AND ANDREWS, GOULD A. Pathological Changes Following Intracavitary Therapy with Colloidal Au^{198} 315
YUHL, ERIC T., ET AL. Use of Colloidal Au^{198} for Obtaining Scintigrams of the Liver 315
BARCLAY, W. R., ET AL. Distribution and Excretion of Radioactive Isoniazid in Tuberculous Patients 315
COX, L. WOODROW, AND CHALMERS, T. A. Exchange of Sodium Between Plasma and Extracellular Compartments in Pregnant Women as Determined by Na^{24} Tracer Methods. 316
COX, L. WOODROW, AND CHALMERS, T. A. Transfer of Sodium Across the Human Placenta Determined by Na^{24} Tracer Methods 316
COX, L. WOODROW, AND CHALMERS, T. A. Effect of Pre-Eclamptic Toxaemia on the Exchange of Sodium in the Body and Transfer of Sodium Across the Placenta Measured by Na^{24} Tracer Methods 316
COX, L. WOODROW, AND CHALMERS, T. A. Transfer of Sodium to Amniotic Fluid in Normal and Abnormal Cases, Determined by Na^{24} Tracer Methods 316
COX, L. WOODROW, AND CHALMERS, T. A. Transfer of Sodium to the Placental Blood During the Third Stage of Labour Determined by Na^{24} Tracer Methods 316
BLOCK, MATTHEW, ET AL. Histopathologic Effect of $Arsenic^{76}$ Upon the Hematopoietic Tissues of Patients with Leukemia 316
HALE, WILLIAM M., AND STONER, RICHARD D. Effect of Cobalt-60 Gamma Radiation on Passive Immunity 316

RADIATION EFFECTS

GRAHAM, RUTH M., AND GRAHAM, JOHN B. A Cellular Index of Sensitivity to Ionizing Radiation. The Sensitization Response 317
BROWN, W. M. COURT, ET AL. Discussion on the Radiation Syndrome 317
BARNES, ALLAN C. Production of ACTH in Patient Undergoing Gynecologic Surgery or Receiving Pelvic Irradiation 318
FOGG, L. C., AND COWING, R. F. Effects of Fractionated Doses of X-radiation on Normal and Tumor Tissue 318
WILSON, M. E., AND STOWELL, R. E. Cytological Changes Following Roentgen Irradiation of the Liver in Mice 318
COHN, S. H., AND GONG, J. K. Effect of 2,000 Roentgens Local X-Irradiation on Metabolism and Alkaline Phosphatase Activity of Rat Bone 319
BRUNST, V. V., AND FIGGE, FRANK H. J. Influence of Roentgen Rays Upon Development of the Mouse by Local Irradiation of Some Parts of the Body 319
PEARSON, W. N., ET AL. Effect of Whole-Body X-Irradiation on Urinary B-Vitamin Excretion of Rats 319
HULTBERG, SVEN. Local Enzymatic Treatment of Radiation Necroses of the Skin 320

THE HEAD AND NECK

Pneumo-encephalography, with Special Reference to the Demonstration of the Basal Cisterns. P. W. E. Sheldon, Ingmar Wickbom, and J. B. Pennybacker. J. Fac. Radiologists **4**: 275–285, April 1953.

The encephalographic technic for examination of the posterior fossa, which has been ascribed to Robertson, has been previously described by Lindgren (Acta radiol. **31**: 161, 1949. Abst. in Radiology **54**: 130, 1950). By means of this technic, not only the fourth ventricle and aqueduct of Sylvius, but also the cisterns of the posterior fossa, may be visualized, with radiographic control of the air-filling and the loss of a minimal amount of cerebrospinal fluid.

Among the advantages of the method over conventional encephalography are the following. Only a small amount of air (about 25 c.c.) is needed. (2) Satisfactory filling of the ventricles is more likely to be achieved, since inflow of air is checked and the position of the head altered, as necessary, during the procedure. (3) The fourth ventricle and the aqueduct are more consistently and accurately demonstrated because air remains in them as long as the head is kept in the same position. (4) The ventricles and cisterns are visualized at the same examination.

Five case summaries with radiographic and diagrammatic illustrations are presented: 2 cholesteatomas, 1 each arising from the fourth ventricle and the right cerebellopontine angle; 1 meningioma at the medial end of the lesser wing of the sphenoid; 1 recurrent hemangioblastoma of the right cerebellar lobe; 1 chromophobe adenoma of the pituitary. The advantage of visualization of the cisterns is emphasized by these cases.

The authors have had little experience with the use of encephalography in cases with increased intracranial pressure. Although they express some doubt that the procedure may be significantly more hazardous than ventriculography under similar circumstances, they advise the exercise of certain precautions in the face of raised intracranial pressure. Preliminary burr holes should be made so that pressure can be relieved quickly and, whenever possible, surgery should be carried out the same day as the examination. No cerebrospinal fluid should be removed after injection of air, provided only 10 to 15 c.c. has been introduced.

Eighteen roentgenograms (retouched); 10 sketches; 1 photograph.

JOHN F. RIESSER, M.D.
Springfield, Ohio

Symptoms and Signs Referable to the Basal Ganglia in Brain Tumor. Daniel Sciarra and Bertram E. Sprofkin. Arch. Neurol. & Psychiat. **69**: 450–461, April 1953.

The authors reviewed the 474 cases of brain tumor seen in the Neurological Institute of New York during the past two years and found extrapyramidal signs and symptoms in 10, or 2 per cent, of these. Case histories of these patients and two others seen previously are given. A review of the literature is included.

The 12 cases represent a histologically varied group: 5 glioblastomas, 2 astrocytomas, 1 fibroma, 1 metastatic carcinoma, and 3 unverified tumors. In 11 of the 12 patients the presenting complaint was abnormal voluntary movements. Four exhibited athetoid or choreo-athetoid movements. In 7 there was rigidity, and 5 of these presented cog-wheel rigidity of the muscles. Six showed poverty of movement and a like number had decreased associated movements. Four presented masked facies.

Routine roentgenograms of the skull demonstrated a shift in the pineal in 5 patients. Abnormal calcification was present in 3 and in 2 there was roentgen evidence of increased intracranial pressure. Pneumoencephalograms were obtained in 3 patients, and ventriculograms in 6. Of these, 3 came to necropsy and 1 had surgery. The roentgen diagnosis and final diagnosis agreed in all 4.

Three roentgenograms; 4 photographs; 1 table.

R. F. LEWIS, M.D.
Cleveland Clinic

Vertebral Angiography in the Diagnosis of Acoustic Nerve Tumors. Olle Olsson. Acta radiol. **39**: 265–272, April 1953.

The author presents an analysis of the angiographic appearance of acoustic nerve tumors in 14 patients ranging in age from fifteen to sixty-one years. The diagnosis in all cases was subsequently verified at surgery. Eleven of the tumors were on the right side and 3 on the left. The vertebral artery was catheterized *via* the radial artery.

In 9 of the cases, widening of the porus acusticus internus on the side of the tumor was observed on plain skull films, and in 1 case destruction of the apex of the petrous pyramid on the involved side was noted.

The angiographic series included lateral and half-axial films and sometimes special views of the area over the lesion. The vascular patterns varied widely from one patient to another, but certain characteristics were recognized:

(*a*) In 10 of the cases the basilar artery was displaced from the midline away from the side of the tumor. However, the author cautions that in view of the wide normal variations, in position, the diagnostic significance of this observation is inconclusive.

(*b*) In 8 of the cases there was asymmetry in the course of the posterior cerebral arteries, the curve being flattened on the affected side.

(*c*) In 13 cases the superior cerebellar artery was displaced cranially and its normal arch was flattened on the affected side.

(*d*) In 9 cases, abnormal vessels were associated with the tumor. Twice these consisted of fine arcuate vessels partly encompassing the tumor. In the other cases, an irregular network of fine tortuous vessels was seen in the area of the lesion.

The author concludes that the value of vertebral angiography has been established and will be enhanced when more information regarding the roentgen anatomy of the small vessels in the posterior fossa has been collected.

Eleven roentgenograms.

ALVIN J. GREENBERG, M.D.
Mt. Sinai Hospital of Cleveland

Lipoma of the Corpus Callosum. Case Report. Charles D. Smith and Edgar N. Weaver. Am. J. Roentgenol. **69:** 605–607, April 1953.

A 15-year-old girl was seen because of two convulsions about one month apart. She had suffered from generalized headaches for several years, but these had never been incapacitating. Physical and neurological examinations were negative. The eyegrounds were normal. The spinal fluid cell count and protein were normal, and the Wassermann reaction was negative.

The lateral skull roentgenogram showed a shadow of increased radiolucency just anterior to the middle of the cranial cavity and about midway between the floor and the vault of the skull. On the postero-anterior view were two thin crescent-shaped lines about 4 cm. apart, centered on the sagittal plane, representing calcium deposits. They appeared to outline the lateral borders of the mass. A sagittal view of the skull after spinal air injection revealed separation of lateral ventricles by the calcium-bordered mass. The appearance of the ventricular system suggested replacement of the corpus callosum by fat tissue. Operation was not undertaken.

The importance of recognition of lipoma of the corpus callosum before surgical exploration cannot be overemphasized, inasmuch as no surgical technic has been devised to allow safe removal of this tumor. Routine films in lateral and sagittal planes which show an area of diminished density in the region of the corpus callosum when air has not been injected and the demonstration of crescentic calcium deposits in the sagittal view seem to be pathognomonic of this tumor. Usually no further views of the skull are indicated, except perhaps for confirmation of the diagnosis.

Four roentgenograms.

RICHARD A. ELMER, M.D.
Atlanta, Ga.

Intracranial Calcification as a Late Result of Tuberculous Meningitis Following Treatment by Streptomycin. R. Garsche. Fortschr. a. d. Geb. d. Röntgenstrahlen **78:** 391–396, April 1953. (In German)

Most cases of acute meningitis show no residual radiologic changes. After long standing disease, however, with increased intracranial pressure there may be recognizable changes in the brain and skull structures. These are found chiefly in tuberculous meningitis after healing, especially in those cases which have been treated by streptomycin. Between 1947 and 1950 the author observed intracranial calcification in 12 cases.

On x-ray examination, distribution of the calcium appeared to be practically the same in all cases, the deposits being above and about the region of the sella, occupying a medial or paramedial position as seen in fronto-occipital views. In the average case, formation of these deposits appeared to take from six to twelve months and there was no evidence of resorption at a later date. The interval between the first acute attack and appearance of calcium on the x-ray film was approximately two and one-half years, independent of the severity or duration of the attack.

The calcium deposits may be fairly compact or may occur as scattered punctate areas. They are particularly notable in the regions of the basal cisterns. They seldom have been shown to reach the region of the third ventricle. It is believed that they originate in inflammatory exudate, often under considerable pressure during the active stage of the disease. In autopsied cases it has been found that, during the healing stage, the exudate has not entirely resorbed, and there is organization with formation of fibrous tissue in which the calcium is later deposited. Frequently the calcium has a shell-like appearance on the x-ray film.

The importance of these calcific deposits is not clearly established. They are regarded as of significance mainly in differential diagnosis. They are to be distinguished from craniopharyngiomas, gliomas, and other mass lesions in the base of the brain, calcifications in arteriovenous aneurysms, chordoma, and toxoplasmosis.

Five roentgenograms. E. W. SPACKMAN, M.D.
Fort Worth, Texas

Spontaneous Intracranial Hemorrhage in Children. Report of Eight Cases in Children Fifteen Years of Age or Younger. Wallace P. Ritchie and Gerald Haines. Arch. Surg. **66:** 452–460, April 1953.

Spontaneous intracranial hemorrhage occurring in children presents problems of diagnosis and treatment similar to those in adults. Vascular anomalies, either aneurysmal or angiomatous, are the commonest cause of this type of accident. Hemorrhage as a result of toxins, infectious diseases, blood dyscrasias, and tumors is rare. True aneurysms are the commonest vascular anomaly in adults, while angiomatous malformations are more usual in children.

This report deals with spontaneous intracranial hemorrhage in 8 children fifteen years of age or younger. Two patients died and 6 recovered. Four were found to have angiomatous malformations. In 3 cases, no cause was proved. In the remaining case the bleeding was thought to be due to an aneurysm of the intracranial portion of the internal carotid artery.

The authors stress the importance of adequate diagnostic studies with angiography so that accurate localization of the lesion can be obtained prior to surgical intervention.

Eleven roentgenograms; 2 photomicrographs.

SEYMOUR A. KAUFMAN, M.D.
Boston, Mass.

The Healing Aspects of Skull Fractures in Children. H.-W. Pia. Fortschr. a. d. Geb. d. Röntgenstrahlen **78:** 396–399, April 1953. (In German)

The literature indicates that skull fractures in children reach a final stage of healing after four and a half months to four years, depending on the nature and degree of displacement of the fragments. Fractures in the occipital region are believed in general to show slower repair than those in other areas. Impression fractures, splintered and comminuted fractures often heal more rapidly than the other types, frequently within four or five months, and in most cases within a year. It is generally recognized that marked displacement and defects at the fracture site delay healing, which is often achieved by fibrous union. It has been stated that fractures of over 5 cm. never heal by bony union.

Unfortunate results may be due to a displaced fragment with destruction of the inner and outer osteoplastic layers of the periosteum, interposition of scar tissue, and damage or rupture of the dura. It has been shown that callus forms largely from the dura. A separation fracture may show osseous healing with the greatest amount of repair in the region of the inner table.

A depressed fracture very often shows the greatest callus formation about the outer table.

The author investigated 39 cases (9 fissure fractures, 15 separated or displaced fractures, 15 impression or depressed fractures), occurring mostly between the ages of four and ten, with the highest incidence at six years. Fissure fractures were occasionally visible roentgenologically after two years, but following that time all disappeared. The separated or displaced fractures showed no visible evidence of a fracture line after two years, though in many there was a considerable sclerotic reaction about the old fracture site. In the group of impressed fractures, if little displacement was present no operation was performed; some showed no resulting defect, while in others a bone defect was still demonstrable after five years.

The author concludes that, in skull fractures in children other than impression fractures with associated defects and damage to the dura, complete bone regeneration occurs within two years. Little difference could be noted in the time required for healing of the various fractures providing there was no gross defect associated with tear or damage to the dura.

Five roentgenograms. E. W. SPACKMAN, M.D.
Fort Worth, Texas

Osteitis of the Sphenoid Sinus. Lewis L. Haas. Arch. Otolaryng. **57**: 427–436, April 1953.

In an earlier paper (Am. J. Roentgenol. **66**: 797, 1951. Abst. in Radiology **59**: 594, 1952), the author described an alteration of the frontal sinus wall observed in 23 of 65 cases of cancer of the paranasal sinuses. The alteration appears on the roentgenogram as blurring, demineralization, and/or condensation of the upper and posterior wall of the sinus. It is not surprising to find similar changes in the sphenoid sinus wall. Roentgenograms of patients given roentgen therapy for paranasal cancer were reviewed. Although on some of the films the sphenoid sinuses were not clearly outlined, a secondary alteration of the wall of the sinus was found in 20 cases and also in 1 case of sinusitis observed during the last year. In 12 of the 20 cancer patients the primary extensive disease was localized to the paranasal sinuses, in 3 to the oropharynx, and in 5 to the nasopharynx. The 1 patient had a chronic pansinusitis of long duration, without malignant growth. In 11 of the 12 patients with paranasal cancer showing changes in the sphenoid sinus wall, an alteration in the frontal sinus was also seen.

The roentgen appearance of the alteration in the sphenoid sinus is similar to that in the frontal sinus previously described. Demineralization is occasionally found, with loss of the white line representing the compact layer of the sinus wall. The majority of the changes appear rather as a more or less marked condensation of the sinus outline. The thickening of the sinus contour or condensation of the surrounding bony structures is slight in some cases and confined to small segments. In others the condensation is more extensive and more marked. In some instances an even, narrow, white stripe is visualized, corresponding to a uniformly thickened sinus wall segment. In the author's case of pansinusitis the even thickening of the outlines was very striking.

The appearance of the roentgen changes suggests a low-grade secondary osteitis due to occlusion and infection caused by the tumor. Clinical observations also support this interpretation and invalidate the explanation that the change in the sinus walls is due to secondary neoplastic involvement. One rarely finds progression of the secondary alteration at a time when the neoplastic bony destruction is progressing rapidly. Patients may remain asymptomatic a long time after surgery or irradiation even though the secondary sinus wall lesions are untreated.

In the author's opinion, secondary changes of the sphenoid sinus wall call for careful clinical and x-ray examination for diagnosis or exclusion of paranasal, nasopharyngeal, and oropharyngeal cancer, and for differentiation from chronic obliterating sinus infection.

Fourteen roentgenograms.

Some Developments in the Technique of Trigeminal Injection. John Penman. Lancet **1**: 760–764, April 18, 1953.

This paper is a sequel to an earlier one on radiological location of the needle for trigeminal nerve injections (Lancet **2**: 268, 1949. Abst. in Radiology **55**: 137, 1950) for relief of tic douloureux. The first requirement for such injections is a puncture point which will give the needle a clear run through the foramen ovale and bring it approximately into the right relation with the petrous bone. A point (Härtel's point) is obtained by measuring from the lambda 4 cm. forward along the sagittal suture and then 2 cm. laterally away from the side of injection. This is marked on the scalp, with two other points in a plane parallel to the plane of the sagittal suture, one 4 cm. anterior to it and the other 4 cm. posterior. A fine wire grid is now made, measuring 4 × 4 cm., subdivided into 16 squares 1 × 1 cm. Where the wires cross at the center of the grid, a small lead shot is placed, and the whole is fixed between two layers of washed film or other suitable transparent material. Next guide lines, described in the earlier paper, are drawn on the patient's face and the grid is fastened onto his cheek with adhesive, so that the lead shot overlies the "conventional puncture point" and one of the two middle wires lies over the line joining the puncture point and the zygoma point (for the location of these points see Harris: The Facial Neuralgias, London, 1937). Three roentgenograms are now taken in three slightly different projections, for all of which the patient's face rests against the film holder and the lead shot is kept in the path of the central ray. The three points previously marked on the scalp are placed in the path of the central ray in turn, one for each projection. The films so exposed show three slightly different outlines of the foramen ovale; the film in which the outline is the most favorable for passage of the needle, neither unduly slit-like nor unduly rounded, is the one selected. It gives a view along the future path of a correctly sloping needle; the pencil of rays which has passed through the foramen ovale has passed also through the grid at the correct puncture point. The direction and distance from the shadow of the lead shot to that of the foramen ovale, as measured on the grid, are the actual direction and distance on the cheek from the conventional puncture point to the correct one.

The remainder of the paper deals with the introduction and aiming of the injection needle, estimation of its depth, accurate measurement of the doses of procaine and alcohol, and the location of the injected alcohol. For the latter purpose a mixture of alcohol with a radiopaque medium (Myodil) is injected and roentgenograms are obtained in basal and oblique projections.

Five illustrations, including 3 grid films.

THE CHEST

Technic of Bronchography in Children. Paul Ch. Schmid. Fortschr. a. d. Geb. d. Röntgenstrahlen **78:** 413–419, April 1953. (In German)

Bronchography has become increasingly important, especially in children, in planning a surgical approach to disease of the chest. The author feels very strongly that the child should have at least a week in the hospital to become used to the new environment before the procedure is attempted. During this time he is examined on several occasions to familiarize him with the head mirror and instruments to be used. A sensitivity test is made the day previous to examination. Two hours before the examination the patient is given 0.1 to 0.2 gm. of luminal by mouth. With children who are quite nervous, 0.5 to 1.0 c.c. of a Dilaudid-atropine solution (containing 0.002 gm. of Dilaudid and 0.0003 gm. of atropine sulfate per cubic centimeter) is given hypodermically. With an especially apprehensive child 0.4 to 1.0 c.c. of Scophedal may be given instead of the Dilaudid-atropine fifteen minutes before examination.

For anesthesia 2 per cent Neopsicain (Merck) is used, the quantity being limited to 5 c.c. The technic of its application is fully described. Evipan-sodium is kept at hand in case of cerebral accident or circulatory or respiratory paralysis. Three hundred and fifty cases have been examined without serious effects. One case showed temporary collapse and another epileptiform convulsions, but in neither were the results serious.

Both oily and water-soluble contrast media are used. The oil gives better contrast, produces less cough reflex, and is distributed more slowly. It is largely eliminated by coughing, but any residual amount in the finer bronchial divisions may lead to granulomatous formation. The water-soluble media are quickly absorbed and excreted through the kidneys after part has been coughed up. There is an occasional toxic effect, but seldom are any changes produced in the lung. Streptomycin or penicillin may be used when indicated. The water-soluble material gives less sharp contrast and requires more thorough and complete anesthesia. The author therefore prefers an oily medium, warmed to 30 to 35° C. He never gives over 20 c.c.

A bronchial catheter with an average diameter of 3 mm. is inserted with the aid of a stilet. The Metras catheter with bent tip is used in older children. In small children, the catheter may be directed by blind insertion or guided by the forefinger, which presses the epiglottis forward. It is best to have the child upright, with the head raised.

Single lobe injection is not often used in children, but usually one side is injected; occasionally, where only the basilar bronchi are to be investigated, both sides are filled.

Films are made in postero-anterior, lateral, and oblique projections. After the procedure is completed, the child does not eat for five hours. He is placed in the head-down position to aid in coughing up the injected material and is fluoroscoped the following day, before dismissal.

E. W. SPACKMAN, M.D.
Fort Worth, Texas

Roentgenology of the Operated Lung. S. di Rienzo. Fortschr. a. d. Geb. d. Röntgenstrahlen **78:** 400–413, April 1953. (In German)

Cases of various types were investigated after removal of an entire lobe or portion of a lobe of the lung. The resulting functional and anatomical changes due to severance of the vessels, nerves, and lymphatics are described. After injection of the opaque medium, studies were made in extreme inspiration, expiration, and on coughing. It was found that the bronchial stump enlarged greatly on inspiration and was smaller on expiration; the stenosis of the stump showed up very well on coughing. The physiological mechanisms involved, including the functional and pressure changes, play a definitely compensatory role, taking up the burden of the excised portion of the lung.

In cases showing altered physiology, in which the mechanism of compensation was inadequate, atelectasis and bronchiectasis were frequently found. Atelectasis was seen more frequently in segmental resections than after lobectomy and pneumonectomy. It was especially noted in resection of the lower lobe or its baslier segment, involving the dorsal segment at the same level. Similar alterations of pressure and disturbed physiological relations may result in bronchiectasis. This frequently occurs in adjacent lobes and may be associated with emphysema. It is possible to have a reflex atelectasis involving the opposite side.

[This work confirms the importance of thorough examination in any case in which lung resection is followed by even mild symptoms of cough, expectoration, etc.—E. W. S.]

Twenty roentgenograms. E. W. SPACKMAN, M.D.
Fort Worth, Texas

Volvulus of a Lobe of the Lung as a Complication of Diaphragmatic Hernia. A Case Report. Herbert T. Ransdell, Jr., and Robert G. Ellison. J. Thoracic Surg. **25:** 341–345, April 1953.

The authors report a case of volvulus of a lobe of the lung which they believe to be the first to appear in the literature. A 21-year-old Negro woman was admitted to the hospital complaining of pain in the chest and stomach. Eight days earlier she had experienced an episode of nausea and vomiting, with crampy epigastric discomfort which radiated to the right upper quadrant of the abdomen and to the lower chest and right supraclavicular and subscapular regions. With this pain there was increasing dyspnea and a mild, hacking, non-productive cough. The patient was admitted to a local hospital with a diagnosis of acute appendicitis. Physical examination revealed a slightly distended abdomen, hyperactive peristalsis, generalized abdominal tenderness most marked in the right upper quadrant, dullness to flatness on percussion over the right chest posteriorly, and absence of breath sounds over the lower chest, though these were present over the upper half. Roentgenograms showed a large right diaphragmatic hernia.

The patient gave no history of other attacks of this kind. She had a mild lifelong dyspnea, which had increased in severity over the past ten years, but no cyanosis. A barium enema showed the distal half of the colon in the right abdomen and the proximal half, together with several loops of the distal small bowel, in the right hemithorax.

Because of the probability of a strangulated loop of intestine, a thoracotomy was performed. The pleural space was filled with 6 to 8 feet of slightly distended small intestine and the proximal half of the large bowel, both of which were covered with a thin, plastic, fibrinous exudate. The herniation had occurred through a posterior and lateral 5-cm. diaphragmatic defect, dis-

placing the mediastinum markedly to the left. The underlying lung was moderately atelectatic and firm. The middle lobe was consolidated, somewhat dry, and slightly necrotic, with severe venous congestion throughout. It was twisted 180 degrees in a clockwise direction on a pedicle 2 to 3 cm. in length and 1.5 cm. in diameter. Upon untwisting the hilar vessels, it was found that they were acutely thrombosed, and the middle lobe was therefore excised. The blood supply of several loops of the herniated small bowel appeared to be impaired. Since attempts to reduce the herniation from above were unsuccessful, the incision was extended to the abdomen and the herniated bowel was replaced with difficulty. Acute pulmonary edema developed a few hours later and the patient died.

Pathologic examination of the surgical specimen showed hemorrhagic infarction of the entire middle lobe. There was much fibrous exudate on the pleura. The blood in the vessels was coagulated but no thrombi were seen. Autopsy revealed severe pulmonary edema, more marked in the remaining lobe on the right, patchy atelectasis, fibrinous exudate over the thickened right pleura, acute lobular pneumonitis, and acute suppurative bronchitis of the right lung. The findings were similar but less severe in the left lung.

The authors conclude that the volvulus of the right middle lobe was apparently due to a congenital anomaly in the form of a long slender pedicle containing the hilar structures of the lobe. It may have been facilitated by the passage of the bowel into the pleural space and possibly by peristaltic action of the bowel.

Five roentgenograms. RENE G. FORTIER, M.D.
St. Paul, Minn.

Pulmonary Histoplasmosis. A Study of Twenty-two Cases with Identification of H. capsulatum in Resected Lesions. Thomas F. Puckett. Am. Rev. Tuberc. **67:** 453–476, April 1953.

Pulmonary tissue was obtained in all of the 22 cases of pulmonary histoplasmosis reported in this study. The diagnosis was not proved until surgery in any of the patients, although it was strongly suspected in several. The symptomatology was found to be of no diagnostic value. Non-productive cough, fever, transient pleural pain, and weight loss were the symptoms which were brought out in some cases by careful questioning after a lesion was detected on a chest roentgenogram. Positive intradermal histoplasmin tests were obtained in all but one patient, and histoplasma complement-fixation reactions were positive in 7 of 12 patients tested.

Four types of the disease could be recognized on the basis of histopathologic findings: (1) focal encapsulated pneumonitis with no satellite lesions (7 cases); (2) a large focus with small epithelioid tubercles or tiny foci of necrosis forming daughter lesions (9 cases); (3) a large focus with smaller nodose or conglomerate foci extending along lymphatic channels (4 cases); (4) a cavity with adjacent tubercles and necrotic foci (1 case). Roentgen findings tended to indicate the anatomic type of lesion except that some of the daughter foci were microscopic in size and not visible roentgenographically. Typical was the presence of a sharply circumscribed nodular lesion with or without small daughter nodules.

The roentgen findings are not particularly diagnostic and the disease may simulate pulmonary tuberculosis or other fungous infections. Cavitation is rare, and lymph node involvement is relatively minimal as compared with involvement in "primary" tuberculosis.

The author assumes that the lesions in the present series are those of primary histoplasmosis, which is somewhat comparable to the primary lesion of tuberculosis, and suggests the term "histoplasmoma" for the pulmonary nodule. The disease has not been studied sufficiently to make this more than an assumption. Because of the non-specificity of pulmonary findings, all adjuncts to diagnosis should be used in these cases.

Two roentgenograms; 10 photomicrographs; 5 photographs; 3 tables. JOHN H. JUHL, M.D.
Minneapolis, Minn.

Coexisting Pulmonary Coccidioidomycosis and Tuberculosis. Hans F. Stein. Am. Rev. Tuberc. **67:** 477–489, April 1953.

It is probable that the coexistence of coccidioidomycosis and tuberculosis is more common than the literature would indicate. Six of a total of 15 cases at the Tucson Veterans Administration Hospital are reported. It does not appear likely that coccidioidomycosis predisposes to tuberculosis, since in relatively few of the large number of cases of coccidioidomycosis occurring in endemic areas does tuberculosis subsequently develop. On the other hand, it is possible that in some cases the necrotizing lesions of coccidioidomycosis could break down and reactivate walled-off tuberculosis.

Although a double infection would seem to be worse than either disease alone, a study of the cases presented here tends to confirm the theory that neither disease seems to affect the other adversely. Since coccidioidomycosis is usually a relatively benign condition, treatment should be directed to the tuberculosis. Pulmonary resection is indicated in many cases because the coccidioidal cavities respond poorly to collapse therapy.

Fourteen roentgenograms; 1 photograph.
JOHN H. JUHL, M.D.
Minneapolis, Minn.

Pulmonary Hematoma. John M. Salyer, Hu A. Blake, and James H. Forsee. J. Thoracic Surg. **25:** 336–340, April 1953.

The authors present 3 reports of hematoma of the lung in soldiers under twenty-five years of age. All 3 patients had been in automobile accidents and sustained non-penetrating injuries of the thoracic cage, with several rib fractures. In one instance the hematoma developed contralateral to the rib fractures.

Roentgenographically the hematomas appeared as round or ovoid densities in the lung substance. The appearance in one instance was that of a cyst-like intrapulmonary lesion. The size ranged from 2.5 cm. in diameter to 4 × 7 cm. Laboratory tests and bronchoscopic studies were negative.

The patients were observed for periods of eight, ten, and twelve weeks, during which there was no appreciable change in the lesions. The possibility of a hematoma was considered in each case, but because malignant growth could not be absolutely ruled out, operation was done—lobectomy in 2 instances and wedge resection in the third. All the lesions were diagnosed microscopically as hematomas. Recovery was uneventful in each instance.

The authors state that it is difficult to predict what the final outcome of a large pulmonary hematoma would

be without surgical excision. In any event, exploratory thoracotomy is indicated because of the difficulty of differentiation from a neoplastic pulmonary lesion.

Four roentgenograms; 1 photograph.

RENE G. FORTIER, M.D.
St. Paul, Minn.

Bronchial and Pulmonary Hamartochondromas. Paul Santy, Pierre Galy, and Roger Touraine. J. franç. de méd. et chir. thorac. **7:** 329–345, 1953. (In French)

Although anatomopathologic descriptions of hamartochondromas have been published since 1863 (Virchow), only in the past few years has clinical interest in this lesion been stimulated, due largely to the more frequent local excision of solitary nodules in the lung. The tumor may be encountered at any age. It is found more often in men than in women.

From the clinical, radiologic, and diagnostic view it is necessary to separate intrapulmonary and endobronchial forms. The intrapulmonary form usually causes no clinical symptoms and is often found incidentally during radiography of the chest. Roentgenographically, a well demarcated, round nodule of soft-tissue density is noted. At times, a few small deposits of calcium may be seen near the center of the tumor This radiologic picture may be simulated by primary or secondary carcinoma, chondroma, tuberculoma, adenoma, and hydatid cyst.

The endobronchial form gives rise to bronchial irritation, ventilatory disturbance, suppuration, and bronchiectasis. Bronchoscopy reveals a polypoid tumor, rounded, smooth or mammillated, usually covered by mucosa.

When no calcification is present, the intrapulmonary form should be removed, as this is then the only way to rule out carcinoma. The endobronchial forms may be removed through the bronchoscope or may require excision via thoracotomy.

Three roentgenograms; 4 photographs; 4 photomicrographs.

CHARLES M. NICE, M.D.
University of Minnesota

Pulmonary Arteriovenous Fistula Associated with Hereditary Hemorrhagic Telangiectasis: A Report of Their Occurrence in a Father and Son. John R. Tobin, Jr., and Thomas C. Wilder. Ann. Int. Med. **38:** 868–877, April 1953.

The authors reiterate the fundamental relationship between pulmonary arteriovenous fistula and hereditary hemorrhagic telangiectasis. Pulmonary arteriovenous fistula is a relatively rare circulatory disorder. Hereditary hemorrhagic telangiectasis is a primary vascular disease that is characterized by cutaneous, mucosal, and visceral telangiectasis and angiomata, and hemorrhages. The lesions are commonly seen on the face and on the mucosal surfaces of the lips, tongue, mouth, and gastrointestinal tract. The severity of the hemorrhages is extremely variable, depending upon the location, fragility, and size of the involved vessels. Repeated hemorrhages result in secondary anemia, chronic debility and, if severe, death. The hereditary nature of the disease is unquestionable. The pulmonary lesions have been variously designated as angiomas, varices, aneurysms, cavernous hemangiomas, and arteriovenous fistulas.

The classic clinical features of pulmonary arteriovenous fistula are largely the result of chronic anoxemia due to the shunting of blood directly from the pulmonary arterial system, by-passing the pulmonary capillary bed. Common subjective symptoms are dyspnea, dizziness, faintness, palpitation, pain in the chest, thick speech, headache, and paresthesias. Characteristic physical findings are cyanosis and clubbing of the fingers and toes. Auscultation over the lung may disclose a bruit. Laboratory investigations usually reveal polycythemia, an elevated hematocrit, increased total blood volume, and decreased oxygen saturation of the arterial blood.

Roentgen examination of the lungs is of great diagnostic importance. Usually a lobulated opacity is noted, with band-like linear or sinuous trunks connected to the hilus. Fluoroscopy may reveal pulsation both in the lesion and in the hilus on the same side. Valsalva's test may result in a decrease in the size of the shadow, whereas Mueller's test may cause an increase.

Conditions with which pulmonary arteriovenous fistula may be confused are congenital heart disease and polycythemia vera. The characteristic morphologic changes in the peripheral blood which accompany polycythemia vera, *i.e.*, immature leukocytes, basophilia, and an increased platelet count, should serve to prevent its confusion with pulmonary arteriovenous fistula. In either instance, the presence or absence of the characteristic pulmonary shadow of pulmonary arteriovenous fistula should clarify the diagnosis.

The treatment of a pulmonary arteriovenous fistula is surgical. If the lesions are multiple, more than one procedure may be necessary. Patients with small lesions and no symptoms may be kept under observation and operation deferred until physiologic alterations require it. Fatal pulmonary hemorrhage and intravascular clotting are constant threats.

Pulmonary arteriovenous fistula has been repeatedly shown to complicate hereditary hemorrhagic telangiectasis and should be sought in every instance of the latter disease. It may otherwise escape recognition.

Two cases of hereditary hemorrhagic telangiectasis with pulmonary arteriovenous fistula in a father and son are presented. In one instance the complicating lesion was removed by lobectomy, with cure.

Seven roentgenograms; 1 photograph.

STEPHEN N. TAGER, M.D.
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Solitary Pleural Mesotheliomas. Hector W. Benoit Jr., and Lauren V. Ackerman. J. Thoracic Surg. **25:** 346–357, April 1953.

There are two types of pleural mesothelioma. One is a diffuse spreading variety, highly malignant and showing epithelial elements forming tubular structures microscopically. The other group consists of benign and malignant solitary fibrous mesotheliomas. These lesions are lacking in any epithelial elements, but consist of a bizarre stroma with spindle cells predominating. The benign solitary mesotheliomas show no mitoses and the cells are uniform in character. The tumors arise from localized areas of parietal or visceral pleura and project freely out into the pleural space. The malignant solitary mesothelioma has a tendency to invade adjacent areas of lung and does not project into the free pleural space. Microscopically this variety exhibits evident mitosis, with marked variations of size and staining properties of the spindle cells.

The authors present 6 cases of solitary pleural mesothelioma, all benign, and analyze the clinical aspects in a group including these and 11 cases from the literature. The youngest patient in this series was twelve years of age and the oldest sixty-four. The mean age was fifty years. No sex preference was evident. Chest pain of a mild and intermittent character was the most common complaint. A mildly productive cough was mentioned by 5 patients. Two of the latter had hemoptysis. Four patients showed moderate fever, mild exertional dyspnea, and weight loss. In 3 cases, the presenting complaint was a severe arthralgia and clubbing of the digits. The arthralgia regressed promptly following surgery and there was a gradual but complete disappearance of osteoarthropathy. Usually the lesions were discovered by routine x-ray examinations, the symptoms mentioned above being elicited after detailed questioning in many cases. It is difficult to make a diagnosis of these lesions by x-ray examination alone. To be differentiated are bronchogenic carcinoma, bronchial adenoma, metastatic carcinoma, pericardial cyst, interlobar effusion, mediastinal tumor, and mesothelioma.

The gross appearance of the tumors is characteristic at the operating table. They are well encapsulated, arising from either the visceral or parietal pleura. They have a nodular appearance, with dilated veins coursing over the surface. The malignant type of fibrous mesothelioma, though arising from the pleura, tends to spread out subpleurally and invade adjacent lung. Treatment consists in surgical removal. The malignant tumors metastasize slowly; local recurrence is the usual pattern.

Six roentgenograms; 3 photographs; 1 photomicrograph.

RENE G. FORTIER, M.D.
St. Paul, Minn.

Tonsillar Hypertrophy and Mediastinal-Hilar Adenopathy. Carlo Dazzi. Ann. radiol. diag. **26**: 115–152, 1953. (In Italian)

A recent Italian study (Rossi) disclosed an unexpected incidence of hilar, paratracheal, and mediastinal adenopathy in children with tonsillar hypertrophy, with a high percentage of positive tuberculin tests. This shows the importance of radiologic examination before proceeding with tonsillectomy, since this is contraindicated in the presence of active tuberculosis. Laminagraphy has been shown of value in demonstrating the hilar and mediastinal nodes and differentiating them from confusing shadows.

The present report concerns 116 children with tonsillar hypertrophy. Each was subjected to clinical, radiographic, and tuberculin studies. Seventy-two of the children had normal hili and negative tuberculin tests; these were not subjected to laminagraphy. Forty-four children had hilar shadows which raised a suspicion of adenopathy; mediastinal laminagraphy was done in these cases and 24 showed mediastinal-hilar adenopathy, some with calcification. In all but 1 of these 24 children the tuberculin test was positive. The associated findings of anemia, malaise, evening fever, and cervical lymphadenitis all pointed toward an active tuberculous infection. One child had a parenchymal lesion, surely tuberculous; 2 others had pleurisy. The one patient with a negative Mantoux test had a cryptic purulent tonsillitis and showed a slight mediastinal-hilar adenopathy. The tuberculous nature of this case is doubtful, and the adenopathy may well have represented a non-specific lymphoid reaction to the infected tonsils.

The tonsillar disease in the cases with the hilar-mediastinal adenopathy and positive skin tests may be either a primary tuberculous process or represent part of a non-specific generalized lymphoid reaction to primary pulmonary disease.

Thirty-three roentgenograms.

CHRISTIAN V. CIMMINO, M.D.
Fredericksburg, Va.

Mediastinal Emphysema Following Tonsillectomy. Jacob J. Silverman, Theodore J. Talbot, and Robert W. McClean. Dis. of Chest **23**: 397–402, April 1953.

Mediastinal emphysema is seen as a complication of a wide variety of conditions. This report describes its occurrence following routine tonsillectomy.

The patient was an 8-year-old boy who is described as "extremely belligerent." He displayed laryngeal spasm and considerable struggling prior to the operation and moderate bleeding and restlessness thereafter. Ten hours following the operation, swelling of the neck was observed, which progressed eventually to involve the entire face. The child became dyspneic, cyanotic, and increasingly restless. Crepitation was present bilaterally in the neck, both axillae, and the chest wall. A roentgenogram showed mediastinal emphysema, best seen in a lateral view, though no pneumothorax was detected. Conservative therapy was followed by improvement in the child's condition and gradual subsidence of the emphysema after the third postoperative day. He was discharged on the sixth postoperative day and a year later showed no abnormality.

An interesting discussion is presented on the mechanism of production of subcutaneous emphysema. The primary source of the escaped air is a ruptured pulmonary alveolus or alveoli, resulting from an excessive rise in intrapulmonary pressure. An interstitial pulmonary emphysema is produced, and the air may travel along the connective-tissue septa of the lung to the periphery to form subpleural blebs, which may subsequently rupture and cause a pneumothorax, or it may dissect its way to the hilus of the lung and produce mediastinal emphysema. The authors feel that mediastinal emphysema is a necessary precursor of subcutaneous emphysema complicating tonsillectomy.

Mediastinal emphysema may appear in any circumstances involving forceful expiration effort against a closed glottis and may develop during violent straining or intense physical exertion of any kind. In the authors' case it is believed to have been a result of the struggling and resistance displayed preoperatively in the operating room. The rarity of the condition should not cause it to be overlooked or misinterpreted.

Two roentgenograms; 2 photographs; 1 table.

LAWRENCE R. JAMES, M.D.
Boston, Mass.

Parathyroid Tumour with Hyperparathyroidism and Coexistent Gastric and Duodenal Ulceration. A. Elkeles. Lancet **1**: 770–772, April 18, 1953.

A case of an unusually large parathyroid tumor in the upper mediastinum with coexistent gastric and duodenal ulceration is reported. The patient's illness showed three stages. The first was characterized by multiple renal calculi, for which a left nephrectomy was done in 1941. These are believed to have been due

to hyperparathyroidism, though this seems not to have been considered at the time. The second stage was dominated by involvement of the skeletal system, with pathological fractures. At this time (1949) roentgenograms showed a large, well defined mass in the right upper mediastinum interpreted as a malignant tumor and treated ineffectively with deep roentgen therapy. The patient's final admission to the hospital (1951) was for severe epigastric pain due to gastric and duodenal ulceration. The chest film again showed a large mediastinal mass, with a rim of calcification and displacement of the trachea to the left but no evidence of infiltration of adjacent structures. Skeletal studies revealed generalized osteoporosis, fibrocystic changes at the sites of the previous fractures, and a moth-eaten appearance of the skull with osteoporosis of the facial bones. The diagnosis of hyperparathyroidism made at this time was confirmed by laboratory findings.

The patient also showed rather extensive calcification of the abdominal aorta, a finding not uncommon in association with gastric ulcer in older persons. On this basis and in view of previous observations, the author suggests an etiologic relationship between arteriosclerosis and the occurrence of gastric or duodenal ulcer in hyperparathyroidism.

Three roentgenograms.

The Radiologic Appearances of the Heart, Oesophagus, and Lungs in Funnel Chest Deformity. Nils P. G. Edling. Acta radiol. **39**: 273–280, April 1953.

The author has examined 66 cases of funnel chest radiologically. There were 49 "mild" cases (less than 2.5 cm. depression) and 17 "severe" cases (greater than 2.5 cm.). The heart remained in a median position in 48 of the mild cases but was displaced to the left in 11 of the 17 severe cases. A straight left cardiac border was present in 3 of the mild and 11 of the severe cases. Apparent cardiac enlargement was observed in 10 cases, but this is usually due to inability to distinguish the right cardiac border through the shadow of the spine. A heavier film enables the viewer to estimate the size more accurately.

When a straight left cardiac border or apparent cardiac enlargement is present without displacement to the left, it may be due to a flattening of the cardiac mass and a more vertical position of the heart. In laterally displaced hearts the straight left border may be explained by the more vertical position and backward rotation on the left side.

Two of the severe cases showed displacement of the esophagus to the left, indicative of displacement of the entire lower mediastinum.

In 7 of the severe cases in which the heart was displaced to the left, there was a density in the lower medial part of the right lung due to end-on visualization of the edge of the sternal depression. This may be misdiagnosed as a parenchymal lesion if lateral views are not taken.

The author's findings are for the most part in agreement with those of earlier writers.

Nine roentgenograms. JAMES H. GROVE, M.D.
Mt. Sinai Hospital of Cleveland

Detection of Cardiac Abnormalities by Mass Chest X-Ray Surveys. G. Howard Gowen. Dis. of Chest **23**: 383–389, April 1953.

Among the various findings on 70-mm. x-ray films taken during mass surveys, cardiac enlargement is quite common. In order to determine its significance, if possible, a follow-up study was made of those cases detected as the result of surveys conducted by the Bureau of Tuberculosis Control (Illinois) from March 1950 to March 1951.

In a group of 154,111 photofluorograms, 515 were suggestive of cardiac abnormality. Questionnaires were sent to the personal physicians of the cardiac suspects, requesting the final diagnosis and other pertinent information. There were 257 complete replies, 244 of which indicated the presence of cardiac abnormality. Of the 244 cases, 21, or 9 per cent, were previously unknown to the patients' physicians. Further analysis revealed that only 8 of the patients in this group were actually in need of therapy or counselling, giving a discovery rate of about 5 per 100,000 persons examined for such cases, which are really the pertinent ones.

The author points out that, in evaluating the heart disease case-finding potential of 70-mm. chest surveys, attention should be paid to the number of previously unknown cases found which are in need of medical attention, not merely to the new cases discovered.

Seven tables. LAWRENCE R. JAMES, M.D.
Boston, Mass.

Angiocardiography in Congenital Heart Disease Correlated with Clinical and Autopsy Findings. A Five-Year Clinical and Pathological Study of Thirty-Four Cases in Infants and Young Children out of a Series of Eleven Hundred Patients, and Four Hundred Twenty-Five Angiocardiograms. Benjamin M. Gasul, Howard Weiss, Egbert H. Fell, Robert F. Dillon, Don L. Fisher, and Carl J. Marienfeld. Am. J. Dis. Child. **85**: 404–443, April 1953.

The authors report 34 cases of congenital malformations of the heart with complete clinical-pathologic correlation with angiocardiography. These cases come from a series of 1,100 patients and 425 angiocardiograms. The cases studied were classified as follows:

A. Cyanotic Group:

1. Complete transposition of the great vessels, 7 cases
2. Tetralogy of Fallot, 5 cases
3. Pseudotruncus communis, 2 cases
4. Tricuspid atresia, 2 cases
5. Ebstein's anomaly, 2 cases
6. Tetralogy with interauricular septal defect, 2 cases
7. Pulmonary stenosis with interauricular septal defect, 2 cases

B. Non-Cyanotic Group:

1. Persistent atrioventricularis communis, 1 case
2. Interventricular septal defect, 2 cases
3. Interventricular septal defect and interauricular septal defect combined, 4 cases
4. Coarctation of the aorta, 2 cases
5. Endocardial fibroelastosis, 2 cases
6. Eisenmenger's complex, 1 case

The authors present these 34 cases, 25 of which were in children under one year of age, with complete clinical, pathological, and angiocardiographic findings.

There was one death following a second injection of Diodrast half an hour after the first injection and another following the use of the same medium in retrograde arterial angiocardiography. The authors have used Neo-iopax for the last 195 angiocardiograms.

Angiocardiography indicates cardiac shunts and abnormalities in size, shape, and position of the great vessels, as well as of the cardiac chambers, and demonstrates disturbances in the return of the great veins to the heart. It is viewed chiefly as another laboratory aid, which must be correlated with the history, physical findings, roentgenographic and fluoroscopic observations and results of cardiac catheterization.

The procedure is most valuable in the cyanotic infants where the roentgenographic and electrocardiographic evidence may be difficult to interpret and in those where cardiac catheterization may be difficult or impossible. It is of less value in the non-cyanotic group.

From an academic standpoint, angiocardiography is useful in furthering understanding of abnormal hemodynamics in congenital heart disease.

Thirty-three roentgenograms; 13 tables.

M. HARLAN JOHNSTON, M.D.
Jacksonville, Fla.

Coarctation of the Thoracic Aorta. Signs Demonstrable by Conventional Roentgenography. Laurence L. Robbins and Stanley M. Wyman. New England J. Med. **248:** 747–752, April 30, 1953.

Coarctation of the aorta, formerly only of academic interest, is now a surgically correctable condition in most cases. It should be recognized early so that operation may be carried out before changes occur that contraindicate it.

The so-called adult type is the most common, occurring usually in the vicinity of the ductus or ligamentum arteriosum. The ligamentum, patent in some cases but more often obliterated, is situated just proximal to or at the coarctation. The aorta is drawn medially and anteriorly toward the pulmonary artery by the ductus and shows varying degrees of resultant angulation. The extensive collateral circulation arising from the subclavian, intercostal, and epigastric arteries is directly visualized roentgenologically only by contrast studies.

A group of 31 patients, 22 males and 9 females, was studied, 20 of whom had pathological or surgical proof of coarctation of the aorta. The age range was four to sixty-two years.

Notching of the ribs has long been considered the classic roentgenologic sign of coarctation of the aorta. This is only a secondary manifestation, however, and is not limited to or always present in coarctation. Notching is rare in early life. In the series described by the authors it was seen in one child of six years, but it is usually not apparent before twelve years of age. Its presence indicates erosion of the ribs by the enlarged, pulsating intercostal arteries. The internal mammary arteries produce scalloped indentations in the anterior margins of the lungs, suggesting multiple small soft-tissue masses. Time is required for these changes, and in some cases of coarctation no significant notching or evidence of dilatation of the internal mammary arteries is present. In 8 of the series discussed, rib notching was absent or questionable.

Other indirect signs of coarctation are absence of the usual prominence of the aortic knob; absence of the usual aortic-arch impression on the barium-filled esophagus; exaggerated convexity of the proximal descending aorta in a young person, representing the commonly associated dilatation of the aorta below the coarctation; displacement of the barium-filled esophagus, opposite the dilatation, to the right and anteriorly; increased prominence of the ascending aorta and increased amplitude of pulsation; left ventricular hypertrophy and enlargement; and widening of the left superior mediastinum by the dilated left subclavian artery.

Demonstration of the signs of coarctation depends upon the technic of examination and quality of the roentgenograms. Survey chest roentgenography is an aid to the discovery of gross abnormalities. Complete meticulous examination, with fluoroscopy and roentgenography, is necessary, however, for the determination of the character of the abnormality.

There is a preference today for the somewhat overexposed chest film with a gray appearance rather than the sharp black and white contrast formerly favored. Overpenetrated films are highly important to obtain maximum information and to visualize the finer and more vital diagnostic signs. Fluoroscopy and adequate spot films are essential.

Conventional roentgenograms should include at least a routine postero-anterior view, an overexposed postero-anterior projection with grid or Bucky diaphragm, a left anterior oblique, and a lateral film. The use of barium in the esophagus may add greatly to the value of the examination. When surgery is contemplated, angiography is a useful preoperative procedure.

Five roentgenograms; 2 drawings; 1 table.

FRANK T. MORAN, M.D.
Auburn, N. Y.

Radiological Diagnosis of Rheumatic Pericardial Effusion. E. M. M. Besterman and G. T. Thomas. Brit. Heart J. **15:** 113–120, April 1953.

Twenty-one cases of rheumatic pericardial effusion (plus 2 recurrences) were studied in an effort to determine the frequency and reliability of the various x-ray signs of the condition. Convincing clinical signs of effusion were present in all, while 7 were proved by cardiac catheterization and 1 by aspiration. Fifteen cases were observed as the effusion developed and 14 as it subsided.

The most significant early signs noted were a rapid increase in the size of the heart shadow (transverse diameter) and a straightening of the left border, with a change in the shape of the heart shadow, which resembled a pear, water bottle, or onion, depending on the size of the effusion. The cardiodiaphragmatic angle and its changes were not helpful in diagnosis, and the effects of posture on the pericardial contour were of limited value. An increase in the width of the vascular pedicle was found in 13 of the 15 patients. Increased density of the cardiac shadow and disappearance of the descending aortic outline were observed but were frequently present before the development of the effusion. Haziness of the posterior cardiac border in the oblique views was seen frequently in the presence of both small and large effusions.

As the effusions subsided, the transverse diameter of the heart and width of the vascular pedicle decreased and the posterior border of the heart became distinct in the oblique views. Return of the normal contours of the left border and of the shadow of the descending aorta tended to be delayed and sometimes did not occur at all.

Generalized cardiac enlargement due to established valve lesions differs from that of pericardial effusion in that the posterior border of the heart shadow appears clear in the oblique view, the vascular pedicle is not widened, and there is no straightening of the left border.

As regards special diagnostic technics, aspiration and cardiac catheterization are probably the most practical methods. Angiocardiography is usually contraindicated because of the patient's condition. The authors felt that fluoroscopy was of no value, since pulsation was usually within normal limits.

Fourteen roentgenograms; 2 tables.

ZAC F. ENDRESS, M.D.
Pontiac, Mich.

Congenital Aortic Valvular Stenosis. Maurice Campbell and Ralph Kauntze. Brit. Heart J. **15**: 179–194, April 1953.

A rather good case is made by the authors for the view that many cases of aortic stenosis are of congenital origin with superimposed arteriosclerosis rather than primarily calcific or atheromatous. They analyze 40 cases in patients ranging from three to fifty years of age, with this point in mind.

One of the strongest arguments in support of a congenital etiology is the fact that a murmur was heard in early childhood in exactly one-half of the cases. Only 2 had definite histories of rheumatic fever. Three others had doubtful histories, but in none was there any evidence of mitral stenosis, and the course in those who were observed for several years showed none of the special features of rheumatic heart disease.

The pulse pressure was generally low, with depression of the systolic level. The heart was enlarged in only a few cases, and then but slightly. Many showed a left border characteristic of left ventricular hypertrophy, and in nearly all bulging of the first part of the aorta was demonstrable fluoroscopically. Calcification of the aortic valve was seen in only 1 of the 23 patients under twenty-four years of age; it was present in 10 of the 17 patients over twenty-four and was especially common after the age of forty.

In 2 of the authors' cases autopsy findings were available and they describe also 2 specimens seen in Guy's Hospital Museum. In 3 of this group the aortic valve appears to have been bicuspid, another congenital anomaly.

The paper concludes with a discussion of the cause of post-stenotic dilatation as applied to pulmonary and aortic valve lesions. The authors believe that turbulence and possible higher pressure just beyond the valve result in the widening of the ascending aorta which is so common a finding.

Eleven roentgenograms; 3 electrocardiograms; 4 drawings; 1 table.

ZAC F. ENDRESS, M.D.
Pontiac, Mich.

The Cervical Aortic Knuckle Which Resembles an Aneurysm. Cecil Lewis and Lambert Rogers. Lancet **1**: 825–826, April 25, 1953.

A case is reported in which a pulsating mass in the lower part of the right side of the neck, simulating an aneurysm, was found at operation to be a high aortic arch. A left anterior oblique roentgenogram obtained after barium had been swallowed showed a smooth constant concavity in the esophageal outline at the level of the fourth and fifth thoracic vertebrae, believed to be due to the aorta passing behind the esophagus in the region of the tracheal bifurcation. The patient had been under observation for sixteen years, during which time symptoms had never been severe.

One roentgenogram; 2 schematic drawings.

Caval Reflexes in Angiocardiography and the Dynamics of the Right Atrium. Christian Hedman, John Lind, and Carl Wegelius. Brit. Heart J. **15**: 143–149, April 1953.

With the authors' technic of angiocardiography (10 to 12 films per second in 2 planes at a 90° angle, with simultaneous electrocardiography) they are able to see things which occur too rapidly for visualization by ordinary methods. The present article deals with the competency of the orifices of the venae cavae in various phases of the cardiac cycle in normal and abnormal hearts. Regurgitation of the contrast medium from the right atrium into the venae cavae and their proximal branches has been frequently observed in angiocardiographic studies, especially in children, but no previous investigation of the mechanism involved seems to have been conducted.

An anatomical basis for closure of the caval orifices during systole has been demonstrated, but experimental evidence indicated that they remain open. By angiocardiography it was found that in normal hearts during atrial systole the caval orifices do close.

Pseudo-reflux occurred both in normal hearts and in the presence of congenital lesions. In these cases there is a retrograde filling of the venous tributaries by the contrast medium simply because it is unable to enter the atrium during systole, the force of the injection having been insufficient to open the orifice.

True refluxes occur for the most part during—most commonly at the end of—atrial systole. Such refluxes are not seen under normal conditions but are associated with congenital heart lesions, as atrial or ventricular septal defects with significant left-to-right shunts, tetralogy of Fallot, etc., in which there is an extra load on the right atrium. Refluxes in atrial diastole, on the other hand, are sometimes seen in normal hearts as well as in the presence of congenital malformations. They appear to be due to an overloading of the atrium with contrast medium.

Eighteen roentgenograms with electrocardiograms.

ZAC F. ENDRESS, M.D.
Pontiac, Mich.

Anomalous Right Subclavian Artery. J. N. Pattinson. Brit. Heart J. **15**: 150–158, April 1953.

An aberrant right subclavian artery arising as the last branch of the arch of the aorta is a relatively frequent congenital anomaly. The anomalous vessel may arise from the medial or upper aspect of a normal left-sided aortic arch or, less commonly, at the junction of the arch and descending aorta. It is frequently dilated at its origin or is associated with an aortic diverticulum. To reach the right arm, the artery must cross the midline, which it usually does behind the esophagus, though occasionally it passes between the esophagus and trachea or anterior to the trachea. This produces a partial "vascular ring," giving rise to an oblique filling defect in the posterior esophageal wall, demonstrable on the postero-anterior film and sometimes causing dysphagia or dyspnea. The course of the artery is best seen in the lateral view, which shows also a semicircular impression on the posterior wall of the esophagus and narrowing of the esophageal lumen.

It has been noted recently that this anomaly is frequently found in patients with congenital heart disease and, indeed, 4 of the author's 7 cases were associated with the tetralogy of Fallot. These 4 cases are illustrated by angiocardiograms, the others by esopha-

grams. None of the patients had symptoms referable to the anomaly.

Sixteen roentgenograms; 1 drawing.

ZAC F. ENDRESS, M.D.
Pontiac, Mich.

THE DIGESTIVE SYSTEM

Esophageal Ulcer with Severe Kyphoscoliosis. R. Haubrich. Fortschr. a. d. Geb. d. Röntgenstrahlen **78:** 419–428, April 1953. (In German)

In an investigation of 25 patients with symptoms referable to the esophagus, associated with kyphosis of the dorsal spine, within one year after the onset of symptoms, the author discovered 5 ulcers, most frequently in the middle third. This type of ulcer may simulate a traction diverticulum or pseudo-diverticulum (occasionally Luetger's epibronchial pulsion diverticulum type). The most likely location is the angulation formed in the esophagus by the dorsal kyphosis. This is compared to the predilection of gastric ulcer for the lesser curvature angle.

Clinical symptoms are frequently vague and indefinite. The ulcer may be an incidental finding without associated spasm or inflammatory condition or may simulate cholecystitis or angina pectoris. Cardiospasm is not associated but some cases show hypersecretion.

X-ray examination shows the ulcer niche. It is quite important to demonstrate this niche in profile. It is not unusual to find a fleck at the site of ulceration, with convergent folds of the mucosa. Often a slight degree of local stenosis is recognized. It is probable that a local area of lessened resistance, possibly on a purely mechanical basis, predisposes to ulcer. A vascular or nervous disturbance may also play a part.

[Bearing in mind this relationship and detailed study of the esophagus may aid in clearing up an otherwise obscure case. E. W. S.]

Eighteen roentgenograms.

E. W. SPACKMAN, M.D.
Fort Worth, Texas

Carcinoma of the Stomach. Necessity for Re-evaluation of Therapeutic Philosophy. A. Ochsner and J. Blalock. J.A.M.A. **151:** 1377–1384, April 18, 1953.

This is a review of current statistics, ideas, and policies concerning cancer of the stomach. It covers the diagnosis and its difficulties, treatment, survival rates, and relation of type of treatment to the results, concluding with the authors' philosophy in regard to this disease. Cancer of the stomach is not an uncommon condition, but the results of treatment are still not satisfactory, since only about 10 per cent of patients are alive five years after diagnosis and only one-third of the growths are resectable.

Unfortunately gastric cancer in its incipiency produces few or no manifestations. Concerning the diagnosis the authors say: "It is generally thought that the diagnosis of gastric carcinoma is relatively simple, and, of the various diagnostic procedures, roentgen examination of the stomach is thought to be most valuable. In the present series, roentgenologic diagnosis of gastric carcinoma was made in 96.5 per cent of the cases; the diagnosis was missed in only 3.5 per cent. A correct diagnosis in over 96 per cent of instances is an excellent record. Yet it is something which we wish were not possible, because we are of the opinion that the visualization of a gastric lesion that can be diagnosed as carcinoma is possible only when the lesion is far advanced and, all too frequently, has extended beyond the stomach and is inoperable. Although mass roentgenography has been used as a screening technic for gastric carcinoma, it has not proved satisfactory and has not been productive of sufficient correct diagnoses to justify its being used."

"Radical subtotal gastric resection" is advocated for most lesions, *i.e.*, removal of all the first portion of the duodenum, of all the lesser curvature up to the cardia, and of all the greater curvature up to within 5 or 6 cm. of the cardia, as well as removal of all the gastrohepatic, gastrocolic and greater omentum, and of the lymph nodes along the lesser curvature, the subpyloric nodes, the subhepatic nodes, the gastrolineal nodes, and the paraesophageal nodes. This procedure is held to be preferable in general to complete resection, since the survival figures are comparable and fewer digestive disturbances result, probably due to the fact that some of the left vagus fibers remain intact.

In conclusion, the suggestion is made that, in order to increase the salvage rate, it becomes imperative occasionally to explore patients whose clinical symptoms suggest cancer of the stomach, but in whom no positive laboratory findings can be demonstrated.

Seven graphs.

PAUL MASSIK, M.D.
Quincy, Mass.

Pseudodiverticular Sarcoma of the Stomach. Alan B. Skorneck. Am J. Roentgenol. **69:** 590–597, April 1953.

A case report of gastric sarcoma simulating benign gastric diverticulum roentgenographically and gastroscopically is presented. A gastrointestinal study had been performed twenty-one months previously, at which time no abnormality was found. At the time of visualization of the lesion there was noted at the beginning of examination an extragastric accumulation of barium filling a pocket medial and anterior to the upper pars media. It communicated with the stomach by a narrow channel in a stalk arising from an area adjacent to the cardia. The stalk appeared to have fine mucosal markings. When fully distended, the rounded pouch measured 6 × 8 cm. The walls were slightly thickened and irregular, especially at the most dependent portion near the stomach. A second small smooth saccule was outlined near the orifice of the stalk. The sac was limited by the left liver lobe medially and the gastrohepatic ligament inferiorly. The extragastric sac retained barium for at least eight hours, long after the stomach had emptied itself. An unusual feature of this large gastric "diverticulum" was its anterior location and huge size.

At laparotomy a round mass was found measuring 12 cm. in diameter, well circumscribed and covered by a thin veil of gastrohepatic ligament. On palpation it was firm yet yielded a cystic sensation. It was relatively avascular. It was attached to the anterior lesser curvature of the stomach by a stalk in the region of the left gastric artery, just below the esophageal orifice. The tumor and stalk were excised along with a 2-cm. wedge of stomach. The remainder of the stomach was normal to palpation and inspection. No lymph node involvement was found. Pathologic diagnosis was fibrosarcoma of the stomach.

The author states that there is no recorded proved case of gastric diverticulum arising from the anterior wall of the cardiac portion of the stomach and indicates

that if a diverticulum-like outpouching is found in this location the possibility of gastric sarcoma should be strongly considered.

Six roentgenograms; 1 photograph; 1 photomicrograph. RICHARD A. ELMER, M.D.
Atlanta, Ga.

Benign Tumors of the Stomach. Ralph Colp and Vernon A. Weinstein. S. Clin. North America **33**: 433–442, April 1953.

Benign neoplasms of the stomach are not uncommon. Their reported incidence in large autopsy series is about 0.5 per cent, but this, the authors believe, is probably an underestimate.

Pathologically, benign gastric tumors may be divided into two groups, (1) mucosal or epithelial and (2) intramural. The epithelial tumors are adenomas, often referred to as polyps. In the authors' series of 27 cases, 12 were classified as adenomas. The intramural tumors constitute a mixed group derived from any of the tissues in the stomach wall, muscular, fibrous, vascular, nervous, and glandular. Of the present series, 8 were leiomyomas, 2 fibromyomas, 2 neurofibromas, 1 carcinoid, and 2 examples of aberrant pancreas.

These benign tumors are especially prone to bleed from surface ulcerations, and it is this tendency which is responsible for most of the symptoms. Pain and vomiting are caused in some cases by intermittent obstruction at the pylorus by a projecting or prolapsing tumor. Many of the tumors are asymptomatic and are found only on routine examination or incidentally at operation for peptic ulcer. Physical examination usually contributes little of diagnostic value. The laboratory findings include secondary anemia due to bleeding. Seven of 8 patients with polyps examined by the authors showed achlorhydria, but normal gastric acidity was the rule in the intramural lesions.

These benign tumors present as round, smooth, clearly circumscribed filling defects on barium-meal examination. The rugae are not distorted but may be somewhat displaced or widened. There is no interference with gastric peristalsis and the wall of the stomach is pliable. Ulcers on the surface of the tumors may be demonstrable. Errors in roentgen diagnosis may be caused by hypertrophic rugal folds, food particles, foreign bodies, etc. Gastroscopic examination is useful in establishing the diagnosis.

Many of the benign tumors of the stomach unquestionably show tendencies to malignant transformation. The adenomas in particular have been considered to have malignant potentialities, the incidence of malignant change having been variously reported as 6 to 51 per cent. The authors feel that adenomatous polyps should be treated as premalignant lesions, as far as surgical therapy is concerned, and report 2 cases in which carcinoma developed. Many of the intramural tumors may also undergo malignant transformation.

Surgical removal is indicated, the type of operation depending upon such factors as the extent of ulceration, if present, the position of the tumor in the stomach, and the probability of malignant change. Gastric adenomatous polyps present an additional problem because they are often multiple. The authors advocate a very high subtotal resection or even a total gastrectomy, if necessary, in cases of multiple polyps extending to the cardia.

Five roentgenograms. L. R. JAMES, M.D.
Boston, Mass.

Giant Rugae with Normal Overlying Mucosa Simulating Gastric Neoplasm: Report of a Case. Daniel Marshall. Gastroenterology **23**: 665–672, April 1953.

A 68-year-old man complained of indigestion of relatively recent onset, and a weight loss of 17 pounds. Gastric analysis showed achlorhydria on fasting and following histamine. Roentgen examination revealed markedly enlarged folds on the greater curvature of the pars media which could not be erased by palpation and which appeared consistently stiff. While a diagnosis of submucosal inflammatory disease seemed more likely, a malignant lesion could not be ruled out. On gastroscopic examination, however, the mucosal folds, though massive, were normal appearing. Inflation of the stomach with air caused them gradually to become smaller and eventually all but disappear. Four mucosal biopsies showed no evidence of malignant change.

With this evidence, the clinical picture was reevaluated and the substernal pain was attributed to coronary insufficiency. Follow-up study for seven months showed no change in either the radiologic or the gastroscopic appearance of the stomach.

Four roentgenograms. ARTHUR S. TUCKER, M.D.
Cleveland Clinic

Prolapse of Gastric Mucosa: Summary of 150 Cases. Abraham Melamed, Robert S. Haukohl, and Abraham Marck. Gastroenterology **23**: 620–635, April 1953.

The authors adhere to the school of thought which attributes to prolapse of gastric mucosa a definite, if varying, symptomatology. In 2,404 consecutive barium-meal examinations the condition was found 150 times, an incidence of 6.2 per cent. The diagnosis was made more frequently than benign gastric ulcer and was exceeded only by duodenal ulcer. The ages of the 150 patients ranged from eighteen to eighty-one years, the greatest number of cases (47) occurring in the fifth decade.

The prolapses are classified as primary and secondary. The secondary prolapses occur most often as complications in antral gastritis, hypertrophic gastritis, and peptic ulcer. Submucosal edema of the stomach appears to be the cause of prolapse in such unrelated conditions as congestive heart failure and cirrhosis of the liver. A case is presented in which mucosal prolapse was found in association with hepatic cirrhosis and disappeared with successful management of that disease.

The roentgen diagnosis of prolapse of gastric mucosa into the duodenum depends upon the demonstration of rugae extending through the pylorus into the duodenal cap. Such a phenomenon results in a corrugated appearance of the pyloric segment of the stomach and the base of the duodenal bulb. The outline of the filling defect or defects in the cap is usually wavy, conforming to the configuration of the slipping rugae. Cuff-like prolapse results in an atomic-bomb, umbrella-, or mushroom-like defect. In those cases occurring secondary to inflammatory conditions, the roentgen signs of antral gastritis, hypertrophic gastritis, and/or peptic ulcer may be added.

Difficulty is occasionally encountered in differentiating prolapsed mucosa from neoplastic involvement of the distal stomach. This problem arises particularly when a marked "tugging" effect is produced by the redundant and prolapsing mucosa. This results in an annular narrowing and foreshortening of the antrum. If serial views are available, a more accurate appraisal of peristalsis, distensibility, and mucosal pattern is pos-

sible. Polypoid prolapsing mucosa will occasionally cause filling defects similar to those created by hypertrophied Brunner's glands. Inconstancy of the defects in the former is the chief differential point.

The majority of the authors' 150 patients with gastric mucosal prolapse responded satisfactorily to treatment with antispasmodics, mild sedation, and a bland diet. Twelve, however, requested or submitted to surgery for relief. Resections of the redundant mucosa and pyloroplasties have been found inadequate to control symptoms, and the authors recommend partial gastrectomy.

Twelve roentgenograms; 4 photographs and photomicrographs.

ARTHUR TUCKER, M.D.
Cleveland Clinic

Duodenal Herniation of the Gastric Mucosa. F. Granone. Ann. radiol. diag. **26**: 36–63, 1953. (In Italian)

The author presents 22 cases of herniation of the pyloric mucosa into the duodenal cap, confirmed by surgical intervention. He concludes that only the radiological examination can give an accurate diagnosis of this condition, which may cause severe but not necessarily characteristic clinical symptoms.

Twenty-eight roentgenograms; 6 photographs.

CESARE GIANTURCO, M.D.
Urbana, Ill.

Disorders of Motility of the Small Bowel. Ian W. MacPhee. Lancet **1**: 678–679, April 4, 1953.

In spite of its rather general title, this paper deals with but one disorder of small-bowel motility sometimes seen following subtotal gastrectomy. The author encountered 4 instances in more than 400 cases in which that operation had been performed. The specific radiological appearance is one of segmentation of the contents of the small bowel. The normal "feathery" appearance of the jejunum and ileum is lost and the barium collects in distinct aggregations separated by areas of spasm. Although the symptoms are suggestive of "intestinal hurry," actually the passage of the barium meal is delayed. The patients complain of abdominal pain after meals, prostration, and diarrhea. The condition is in some respects similar to idiopathic steatorrhea. It has proved resistant to medical treatment.

Four roentgenograms.

Intestinal Obstruction in the Neonatal Period. George Davison and T. R. Harlan. J. Fac. Radiologists **4**: 286–295, April 1953.

This report concerns the study of 52 cases of organic intestinal obstruction occurring in the first fourteen days of life. Only obstructions between the duodenum and anus are considered, esophageal atresia and pyloric stenosis being excluded. The report is divided into two parts: clinical comment and radiologic aspects.

The types of obstruction encountered were as follows:

Atresias and stenoses	24 cases with	12 deaths
Malrotation	4 cases with	4 deaths
Diaphragmatic hernia	2 cases with	2 deaths
Inguinal hernia	2 cases with	1 death
Meconium ileus	1 case with	1 death
Acute peritonitis	2 cases with	2 deaths
Chronic peritonitis	1 case with	no death
Hirschsprung's disease	16 cases with	8 deaths

An additional 22 infants were seen during the same period of time as those tabulated above, with severe vomiting but (with a single exception) without radiological evidence, either on plain films or a barium meal study, of organic obstruction. These cases, presenting symptoms suggestive of obstruction but with spontaneous recovery, are described as "initial vomiting."

The importance of Hirschsprung's disease as a cause for neonatal obstruction is illustrated by the table. Infants with this disease form almost a third of the total. Imperforate anus is included in the atresias, and there were 4 such cases in this series.

The interpretation of plain films is discussed. Special mention is made of the use of the inverted position in imperforate anus and the use of a lead marker in the external dimple. Barium by enema is, of course, relatively safe and of value in visualization of large bowel obstructions. Barium by mouth is safe in high lesions, but the possibility of involvement of the ileum is a contraindication to its use. The quantity of barium used by mouth should usually not exceed 20 c.c.

Accurate clinical diagnosis is possible in a few cases, but in the majority radiologic study is essential for confirmation. Full consultation and collaboration between the pediatrician and radiologist are essential.

Thirteen roentgenograms; 5 tables.

JOHN F. RIESSER, M.D.
Springfield, Ohio

Regional Enteritis—Its Allergic Aspects. Albert H. Rowe, Albert Rowe, Jr., and Kahn Uyeyama. Gastroenterology **23**: 554–571, April 1953.

The writers record 1 case with positive evidence and 2 cases with probable evidence of food allergy as the cause of regional enteritis which were controlled by elimination diets. The first was that of a woman, 41 years of age, who had diarrhea, fever, abdominal and limb pains, and fatigue for seven years. Two years before she was seen by the authors she had had a resection of more than 2 feet of thickened, inflamed ileum for terminal ileitis. The pathologic specimen showed inflammatory infiltration with epithelioid cells in tubercle-like lesions, Langhans giant cells, and enormous numbers of eosinophils. After surgery the symptoms persisted and were not relieved by streptomycin and sulfonamides. Roentgen examination revealed marked hypermotility of the small bowel. Areas in the ileum showed disturbed mucosal patterns, with narrowing and edema of the mucosa. On a milk-free diet the disease was immediately controlled and the abnormalities observed roentgenologically diminished progressively over a five-year period. The symptoms reappeared in one day when milk was given again, and traces of milk given later caused mild, persistent distress. The milk allergy was not indicated by skin testing or leukopenic index.

The other 2 patients had roentgen findings characteristic of regional enteritis. Both were relieved of symptoms by elimination diets. The authors believe that a recent resection of the terminal ileum in 1 of the patients elsewhere could have been avoided had her diet been maintained.

Regional enteritis, like chronic ulcerative colitis, must be considered to have a possible allergic etiology. Inhalant, drug, and infectant allergies may occur, but food allergy is the most evident cause.

Twelve illustrations, including 8 roentgenograms.

ARTHUR S. TUCKER, M.D.
Cleveland Clinic

Double Contrast Studies of the Colon: Polyps in Children. Charles W. Yates. South. M. J. **46**: 315–319, April 1953.

The author discusses polyps of the colon as seen in children and describes his method of performing the double-contrast study of the colon.

Adenomatous polyps in childhood differ in two respects from similar lesions in adults: (1) the relative infrequency of malignant change and (2) the apparent frequency of self-amputation. In polyps of the heredofamilial type, however, malignant change may occur at a fairly early age. The symptoms of polyps in children are: blood in the stools, observed in practically 100 per cent of the cases, and protrusion, diarrhea, and abdominal cramps in varying degree. In a child with these symptoms, both proctoscopic and x-ray examinations should be done, to be repeated on recurrence or continuation of symptoms following therapy.

The pre-examination preparation is described in detail. For the examination a size 18 Bardex bag is used routinely. The barium mixture, with a suspending agent added, is allowed to flow to the mid-portion of the transverse colon. From there it is carried to the hepatic flexure by tilting the table and rotating the patient. While the barium is entering, fluoroscopy and palpation are carried out as usual. The excess barium is siphoned off by lowering the enema can, tilting the table, and massaging the abdomen as necessary. Air is then injected under fluoroscopic control. The colon must be well distended for the best visualization. In making the roentgenograms, high kilovoltage and milliamperage are used to allow for short exposures. Routinely four projections are made: anteroposterior, postero-anterior, and both supine obliques. Additional views are occasionally obtained if necessary. Speed is essential. A second examination requires repetition of the pre-examination preparation.

Seven roentgenograms are reproduced, demonstrating polyps of the colon very clearly.

JOHN M. KOHL, M.D.
Jefferson Medical College

Paraduodenal Hernias. Philip B. Parsons. Am. J. Roentgenol. **69**: 563–589, April 1953.

The subject of paraduodenal hernias is reviewed and an extensive bibliography is appended (314 references). Theories concerning the formation of the multiple intra-abdominal pouches are discussed. There is also a review of the roentgen findings associated with the ordinary large intra-abdominal hernias, together with differential findings between right and left paraduodenal hernias.

The author seeks to show that small paraduodenal hernias containing from a few inches to several feet of small intestine are associated with symptoms and indicates that the diagnosis can be made preoperatively. Most of the patients with small paraduodenal hernias give a history of upper abdominal cramps, nausea, and vomiting, these findings usually being intermittent over a long period of time. There is frequent epigastric distention, usually on the left. Some patients complain of tightness of clothes in the epigastric region. There may be long intervals between attacks. The onset of symptoms varies from twenty to forty-five minutes following ingestion of food.

For roentgen study a motor meal is given and prone abdominal films are obtained at three and five hours. These films are reviewed by the radiologist before fluoroscopy. In those patients in whom the lesion is present or suspected, there will be found one or more loops of small intestine bunched in the left upper quadrant. In these hernias the stomach is not displaced. There are varying degrees of duodenal stasis. In hernias into those fossae lying immediately at the ligament of Treitz the proximal jejunum may be seen displaced upward and medially, or downward and medially, and outlining a small mass of intestine which contains gas or, in the progress of the ileal series, barium. These encapsulated loops show coarsening of the mucosa, dilatation, and stasis. When these findings are noted, the area is examined fluoroscopically and a second barium meal is given. A film made thirty minutes following the second barium meal is studied and then, judging by the degree of motility, other films are made at intervals of fifteen to thirty minutes. If the findings are inconclusive, the patient returns for a small intestinal series, preferably during an exacerbation of symptoms. Cases have been examined which give a suspicious history but during an asymptomatic period, and the studies have been normal. Subsequent examination during an attack has demonstrated encapsulation. Lateral radiographs of the abdomen have shown retroperitoneal displacement on some occasions, but usually the amount of intestinal encapsulation is too small to define posterior displacement. No intrinsic lesion of the gut has been demonstrated in any of the cases described by the author.

Not only are small paraduodenal hernias reducible spontaneously but they may be inadvertently reduced at the time of laparotomy. The condition can usually be identified best by a left upper quadrant incision. Traction on the intestine used to approach the left upper quadrant could reduce the hernia and in its reduction obliterate the sac so completely that no evidence would remain. In passing through the small fossae, the mesentery of the herniated intestine forms part of the sac wall and a definite sac with clear cut-mouth is not usually found.

Twelve cases of intra-abdominal hernias and 5 cases of bands in the left upper quadrant are reported.

Twenty-one roentgenograms.

RICHARD A. ELMER, M.D.
Atlanta, Ga.

Cholecystectomy and Its Relation to the Stomach and Duodenum. Review of 75 Cases with Preoperative and Postoperative X-ray Studies. Robert E. Rothenberg. Surg., Gynec. & Obst. **96**: 421–426, April 1953.

In an attempt to learn more about the nature of post-cholecystectomy symptoms, 75 patients suffering from cholecystitis and cholelithiasis were subjected to roentgenographic studies of the stomach and duodenum prior to removal of the gallbladder and again some six months to two years after cholecystectomy. Six of the 75, or 8 per cent, suffered from duodenal ulcer as well as from chronic calculous cholecystitis.

In 8 cases (10.6 per cent) the post-cholecystectomy roentgenograms showed duodenal distortion, suggestive of ulcer, though preoperatively the stomach and duodenum had appeared normal. In view of this, the author states that in a patient who has been subjected to cholecystectomy a deformed duodenal cap does not necessarily signify the presence of an ulcer. In these cases, one should be guided by the symptoms rather than the roentgen findings. The 8 patients in this series were symptom-free and in good health despite their abnormal x-ray findings. [The photographs of the

so-called deformed bulbs were studied by this abstracter, who does not believe that any of the bulbs shown warrants the diagnosis of duodenal ulcer. He believes that the criteria for making the diagnosis of duodenal ulcer should be stricter and that an inconstant irregularity of contour is not pathognomonic.]

In this series of cases, cholecystectomy symptoms such as colic, belching, indigestion, and dyskinesia were not found to be associated with abnormal roentgen findings of the stomach or duodenum. Six of the 75 patients (8 per cent) suffered from moderate to severe post-cholecystectomy symptoms though the stomach and duodenum were normal roentgenologically.

Forty-seven roentgenograms.

MORTIMER R. CAMIEL, M.D.
Brooklyn, N. Y.

Operative and Postoperative Cholangiography by Serial Films. K. E. Loose. Fortschr. a. d. Geb. d. Röntgenstrahlen **78:** 437–449, April 1953. (In German)

Various authors have reported between 10 and 20 per cent of operative cases showing residual stones in the biliary tract. Even with the most careful surgical technic, these may be overlooked and cause subsequent difficulty. Cholangiography, therefore, during the operative procedure and also postoperatively is becoming increasingly recognized as a safeguard for the future welfare of the patient. With modern simplified x-ray methods and improved anesthesia, its earlier disadvantages have been largely overcome.

The closest co-operation between surgeon, anesthetist, and radiologist is essential for this procedure. An operative x-ray table is used, with four-valve rectification and Potter-Bucky diaphragm or stationary grid. Extradural spinal anesthesia is preferred by the author, as it allows adequate muscle relaxation and permits the co-operation of the patient, especially in holding the breath. After the abdomen is opened and the biliary tract structures are freed, the x-ray tube is moved over the patient at a focal film distance of 60 cm.

Twenty cubic centimeters of the contrast medium, previously warmed to body temperature, is slowly injected into the gallbladder. The exposure is between one and one-half and two and one-half seconds. Occasionally there is failure of complete filling, in which event a second injection may be made without concern. Thirty per cent Joduron is the preferred medium. Many workers make films from various angles to visualize all parts of the tract. Serial films are obtained at approximately five-minute intervals. In postoperative studies, films are taken every minute to visualize the progress of the medium through the tract.

Spasm may simulate obstruction but is temporary and gives a variable picture as compared to the constant findings in the presence of stone. The serial studies are of particular advantage in differentiating choledochitis or odditis from obstruction due to stone. Stones of moderate size or small stones in groups are easily recognized. Very small stones may be shown only by indirect signs. Occasionally they are identified by diluting the medium.

Cholangiography is strongly recommended by the author to identify intra- and extrahepatic stones, inflammatory and mechanical processes, Ascaris, anomalies, carcinoma of the papilla, and inflammatory conditions. The operative procedure is of greatest value in detecting residual stones along the biliary tract, thus insuring complete removal at the time of operation.

Seventeen roentgenograms; 6 photographs.

E. W. SPACKMAN, M.D.
Fort Worth, Texas

Use of Telepaque in Cholecystography. A Comparative Study. Clark F. Miller and John W. Carrier. New England J. Med. **248:** 709–712, April 23, 1953.

The authors re-examined with Telepaque 13 patients in whom cholecystography with Priodax failed to give adequate visualization of the gallbladder. With Telepaque 6 cases were considered normal and 2 presented clear evidence of stones. In the remaining 5 cases the findings were essentially the same as with Priodax.

It is concluded that Telepaque is superior to Priodax in three ways: it produces a denser shadow, causes fewer side effects, and is more convenient for the patient.

Six roentgenograms; 1 table.

SEYMOUR A. KAUFMAN, M.D.
Boston, Mass.

Diagnosis of Biliary-Pancreatic Cancer. Henry Doubilet, Harold H. Sage, and John H. Mulholland. S. Clin. North America **33:** 461–478, April 1953.

The liver and pancreas originate in early embryonic life as outbuddings of the duodenum, and have common characteristics. Both display an extraordinary ability to regenerate after injury or removal of part of their substance. Both show a peculiar susceptibility to damage produced by nutritional deficiencies, toxins, and viruses.

In some 85 per cent of people there is an anatomical junction of the ducts from the liver and pancreas prior to entry into the duodenum through a single opening. Occlusion of this opening converts the bile and pancreatic ducts into a common passageway. Bile may then enter the pancreas or pancreatic juice may pass into the bile ducts, and, under certain conditions, lead to a chemical inflammation varying from mild edema to hemorrhagic necrosis. Repetition of this process may result in replacement of destroyed tissue by fibrosis. Recurrent inflammation in the presence of constant chemical irritation may eventually result in the formation of cancer, as is attested by the high incidence of primary carcinoma of the liver in relation to cirrhosis and of primary carcinoma of the gallbladder in relation to stones.

The authors discuss at length the relation of biliary-pancreatic cancer to nutrition and to serum amylase and lipase. The secretin test and roentgenography are useful diagnostic procedures. Prior to operation the following roentgen observations are sometimes made: pressure of cancer of the gallbladder on the upper outer aspect of the duodenum; distortion and enlargement of the inner curvature of the duodenum, sometimes in the form of a reversed figure 3; anterior displacement of the stomach; the presence of an ulcer when the tumor has extended into the duodenum. Postoperative cholangiography is often of great value, especially in cases of carcinoma of the hepatic ducts, when the tumor may be difficult to palpate because of its small size and inaccessible position.

Pain in inflammatory diseases of the biliary-pancreatic system is due to two causes: (1) distention of the ducts and (2) acute inflammation. The latter is rarely present in cancer.

The authors stress the fact that, since the symptoms of cancer are due to complicating factors such as incomplete obstruction of the bile or pancreatic ducts, it requires the most astute clinical insight to arouse suspicion of this serious tumor. Vague symptoms of epigastric distress or distention, substernal discomfort, change in bowel habits, etc., in the presence of a nonfunctioning gallbladder or deformed duodenum, are considered justification for surgical exploration. Recurrent mild jaundice in the absence of incontrovertible evidence of liver disease also justifies exploration.

A large number of illustrative cases are included.

Ten roentgenograms. L. R. JAMES, M.D.
Boston, Mass.

A Case of True Pancreatic Cyst in Early Infancy. Alberto Calderin Gomez. Rev. cubana pediat. **25:** 246–263, January 1953.

The infrequency of pancreatic cysts in childhood, especially in early infancy, warrants report of this case. The author reviews the etiologic and pathologic phases of the lesion and discusses not only the diagnosis but also the appropriate surgical procedures. In this instance the tumor was removed successfully and proved to be a true pancreatic cyst.

The roentgen findings were the decisive factor, again proving that roentgenography is the only method by which a positive diagnosis can be made. In this case the observations were as follows: (*a*) The routine film showed a dense soft-tissue tumefaction occupying the entire superior portion of the abdomen, displacing the gas of the stomach posteriorly and somewhat upward, and the intestinal loops downward. (*b*) Opaque enema study showed the distal transverse colon and splenic flexure displaced downward. (*c*) In the left lateral position there was no marked displacement of the plane of the stomach anteriorly. (*d*) The pyelogram showed the left kidney displaced but not deformed.

JAMES T. CASE, M.D.
Santa Barbara, Calif.

THE MUSCULOSKELETAL SYSTEM

The Impact of Röntgen's Discovery upon the Treatment of Fractures. Leonard F. Peltier. Surgery **33:** 579–586, April 1953.

This article on the effect of the discovery of x-rays upon the treatment of fractures is included in the section of the journal entitled "Surgical History." In the conclusion, the author states that the great improvement in the treatment of fractures is due to more accurate diagnosis and to an insistence upon a more exact anatomic reposition of the fragments. The speed with which the new method was developed and accepted was the result of a combination of forces acting within and without the medical profession.

On the Significance of Growth in the Roentgenological Skeletal Changes in Early Congenital Syphilis. Arne Engeset, Sigurd Eek, and Oscar Gilje. Am. J. Roentgenol. **69:** 542–556, April 1953.

The authors discuss qualitative and quantitative disturbances in the growth of bone and the theories of etiology of the skeletal changes in early congenital syphilis. It is their opinion that the zones of rarefaction in infantile congenital syphilis are not on the basis of specific granulation tissue and that the roentgenologic skeletal changes may be interpreted as general quantitative and qualitative disturbances of growth. The skeletal changes may be combined with secondary changes, most frequently traumatic.

The authors' material consists of 59 cases of infantile congenital syphilis; 49 of these cases had been examined roentgenologically and 31 of these presented pathological skeletal changes. The roentgen changes found in this material are illustrated by case reports and accompanying roentgenograms. The presence of zones of rarefaction and periosteal double contours in a newborn infant with a syphilitic mother is not synonymous with the presence of active syphilis in the patient. A wide zone of normal spongy bone epiphyseal to the zone of rarefaction in the metaphysis and normally appearing compact bone surrounding the subperiosteal zone of rarefaction indicate that the patient has been cured and the rarefied zones are merely persisting signs of disturbance of growth due to the syphilitic infection or intoxication in fetal life. The width of the zones of rarefaction, the position of the growth lines, and the width of the newly formed bone epiphyseal to the rarefaction make possible an approximation of the time of onset of disturbance of growth in bone, as well as the initial treatment, and also the nature of the treatment, when bismuth is used as the therapeutic agent. The authors note that the changes in early congenital syphilis, as a rule, heal without leaving scar or deformity. This supports their contention that disturbances of growth may be present rather than destructive inflammatory changes of a specific nature.

Whereas no absolute proof has been offered for the bone changes in infantile congenital syphilis, it is believed that the designations syphilitic enchondritis, diaphysitis, periostitis, etc., should be abandoned and replaced by more neutral terms such as "Parrot's syphilitic dystrophy" or "osteochondroperiostosis."

Fifteen roentgenograms; 10 diagrammatic drawings.

J. L. CLEMENTS, JR., M.D.
Atlanta, Ga.

Diagnostic Problems in Herniated Intervertebral Disk. Raphael R. Goldenberg. Bull. Hosp. Joint Dis. **14:** 86–100, April 1953.

Five cases of low back pain are presented in which the clinical picture resembled closely that usually seen in herniation of the nucleus pulposus. In all a neoplastic process was eventually found to be present. Briefly the cases are as follows:

Case 1: Metastasis to the fifth lumbar vertebra from a carcinoma of the thyroid. Roentgenograms of the lumbosacral region revealed suspicious mottling and slight erosion of the left lamina of the fifth lumbar vertebra.

Case 2: Ependymoma of the spinal cord. X-ray examination was normal except for a loss of normal lordosis.

Case 3: Multiple myeloma with extensive skeletal and visceral involvement. Roentgenograms showed porosis in the body of the third lumbar vertebra, together with destructive changes in the laminae. A biopsy diagnosis of plasma-cell myeloma was made, and subsequent x-ray examination showed a pathologic fracture of the involved vertebra, with absorption of the pedicles, laminae, and spinous processes.

Case 4: Silent carcinoma of the right lung. Myelography showed a deformity of the Pantopaque column, with elevation of the nerve root on the left side of the L5-S1 disk space. Laminectomy was not done,

and the question remains whether this was actually an example of herniated disk or a metastatic focus from the pulmonary lesion.

Case 5: Carcinoma of the kidney with metastases to the intervertebral disk and right paraspinal muscle. Myelography on two occasions showed a defect on the right side of the L5-S1 intervertebral disk space.

The author concludes that "one must always bear in mind that the patient under observation who seems to be another typical case of herniated intervertebral disk may turn out to be a difficult diagnostic problem."

Seven roentgenograms; 6 photomicrographs.

Degeneration of Cervical Intervertebral Disks Following Whip-lash Injury. Abraham Myers. Bull. Hosp. Joint Dis. **14**: 74–85, April 1953.

The majority of injuries of the cervical spine are the result of whip-lash injury, that is, forced flexion with spontaneous extensor recoil. Varying degrees of stretching and tearing of the posterior spinous ligaments and capsular ligaments of the intervertebral joints and injury or crushing of the intervertebral disks occur. Immediate recognition of the problem is desirable so that immobilization in a cervical brace collar or plaster of Paris support may be provided for six to eight weeks to prevent further lengthening and stretching of the ligaments by continued unprotected use. Unfortunately a large percentage of these injuries are not recognized promptly, and the end-results become manifest months or years later, when it may be difficult or impossible to establish a convincing causal relationship.

The majority of whip-lash injuries result from automobile accidents. Forceful pulls on the arm and blows or falls on the head are other mechanisms. The immediate result is pain in the cervical spine, with muscle spasm and partial restriction of motion in the head and neck. Radiation of root pain to the shoulders and upper extremities, with numbness and tingling of the fingers, may occur. Flattening of the cervical lordotic curve due to muscle spasm is the most important clue to the diagnosis.

The unrecognized type of whip-lash injury results in the development of mechanical derangements of the cervical spine from partial subluxations of the cervical facets and vertebral bodies. With progressive degeneration and collapse of the disks, there is pressure on the cervical nerve roots producing a segmental neuritis. Symptoms depend upon the level of the lesion. With involvement of the upper spine there may be occipital headaches, suggesting migraine. When the injury is lower down, at about C-4 or C-5, there may be shortness of breath, palpitation, and pain in the chest as well as in the neck. Pain in the shoulder joint and pain and stiffness of the fingers may occur. With damage at a still lower level, paresthesia of any portion of the upper extremity or shoulder and numbness and tingling of the fingers occur. Irritation of sympathetic fibers may produce burning sensations in the head and neck, shoulders, and upper extremities, swelling of the upper extremities, vertigo, and parasympathetic instabilities. In patients with such symptoms, pointed questioning for whip-lash injury to the neck and radiographic study are indicated.

Films should be taken in the neutral position and in forced extension and flexion, all in lateral projection. Flexion frequently reveals forward displacement of the vertebral bodies. Hyperextension may show posterior displacements. The neutral position reduces such displacements and furnishes a clue to the treatment.

Fifteen roentgenograms. D. DEF. BAUER, M.D.
Coos Bay, Ore.

Mechanism and Treatment of Spinal-Cord Disorders Associated with Cervical Spondylosis. A. R. Taylor. Lancet **1**: 717–720, April 11, 1953.

In addition to symptoms referable to the nerve roots, cervical spondylosis may also cause symptoms attributable to spinal cord compression, though such compression is not apparent to the naked eye either at operation or autopsy. Its clinical manifestations are spastic paraparesis, with or without involvement of one or both upper limbs, or hemi-cord dysfunction.

The author seeks here to show that it is not the protruded disk alone that compresses the cord but also the ligamenta flava, which move forward as the neck is extended, projecting into the spinal canal. Normally the cord escapes damage from this source by also moving forward. If, however, there is a protrusion on the anterior wall of the canal and the cord is further fixed by associated adhesions, it will be intermittently compressed, with resulting gradual change in its vasculature, the exact nature of which remains uncertain. The cord is held in position to receive each impact of recurring compression by the spondylitic elevation in front of it. Myelograms illustrate this phenomenon, showing interruption of the oil column on hyperextension of the neck.

Suggestions for treatment based on this theory are offered. The author's opinion, which he states is tentative, is that where the compressing agent is a nuclear protrusion, as it has been shown to be in some 15 per cent of cases, it should be removed. Where a bony ridge composed of ossified annulus and osteophytes is present, this should be left undisturbed. The approach under these conditions is by laminectomy and removal of the ligamenta flava. A case thus treated is reported.

Six myelograms; 4 sketches.

Benign Form of Acute Osteitis of the Spine in Young Children. A. E. Bremner and G. A. Neligan. Brit. M. J. **1**: 856–860, April 18, 1953.

The authors report 7 cases of what they consider to be low-grade pyogenic osteitis of the lumbar spine occurring in young children presenting a clinical picture not previously adequately described. They believe that the condition is a hematogenous infection of bone, secondarily involving the intervertebral disk, and they present indirect evidence from the literature incriminating *Staphylococcus aureus*.

The patients were all between the ages of nine months and two and a half years at the time of onset. This was insidious, taking the form of a mild or moderate febrile illness with stiff, painful back. Four of the patients had a limp with limitation of motion of a hip. The symptoms increased gradually in severity for five to six weeks and then became stationary or began to improve. Laboratory tests for tuberculosis, syphilis, salmonellosis, and brucellosis were negative in every instance.

Radiographically, all the children showed narrowing of an intervertebral space in the lumbar region with erosion of the adjacent margin of the body of either or both the vertebrae bounding it. In addition, 1 child had posterior displacement of the upper of the 2 in-

volved vertebrae and 2 patients had angular scoliosis at the level of the lesion. These changes were apparent in most cases three to four weeks after onset. In the early stage the changes were indistinguishable from tuberculous spondylitis of the same duration, but recalcification of the eroded portions of the vertebral bodies was evident within three months of onset and actual sclerosis soon followed. The sclerosis and the narrowing of the disk space persisted in all cases throughout the follow-up period.

Treatment consisted of rest in a plaster bed until recalcification was evident roentgenographically. Only 1 patient received penicillin. All remained well four to sixteen months after resuming full activity.

In 1950, Saenger (Am. J. Roentgenol. **64:** 20, 1950. Abst. in Radiology **56:** 913, 1951) reported 4 cases of "spondylarthritis in children" which the present authors feel is identical with the condition which they have described.

Six roentgenograms; 2 tables.

JOHN J. CRAVEN, M.D.
Cleveland Clinic

Giant-Cell Tumor of the Spine. A Report of Two Cases. W. R. Hamsa and L. S. Campbell. J. Bone & Joint Surg. **35-A:** 476–478, April 1953.

Both giant-cell tumors and bone cysts show a predilection for long bones. Giant-cell tumors of the vertebrae are rare. The authors report two such cases, in patients six and fourteen years of age. Both complained of persistent back pain following injury, and roentgenographically both showed destructive vertebral lesions with rather smooth margins. Biopsies were done. The microscopic sections were typical of giant-cell tumor. Both patients received roentgen therapy and were immobilized in plaster. One was later treated by a spine fusion. In the case without spine fusion there was considerable collapse of the bone after treatment.

The authors conclude that either very prolonged immobilization or spine fusion is indicated in cases of this type to prevent collapse after biopsy and roentgen therapy.

Four roentgenograms. RICHARD P. STORRS, M.D.
Syracuse, N. Y.

Chordoma of Lumbar Vertebra. Harvey W. Baker and Bradley L. Coley. J. Bone & Joint Surg. **35-A:** 403–408, April 1953.

Chordomas are slow-growing malignant tumors which arise from elements of the primitive notochord. Heterotopic chordal vestiges are more often the source of chordoma than is the normal remnant of the notochord, the nucleus pulposus.

The sacrococcygeal region is the most common site of origin of chordoma, followed by the cranial region. The spinal column is the least common site, only about 15 per cent of known cases occurring in vertebrae. The lumbar vertebrae are most frequently involved. The symptoms are of insidious onset, consisting of dull pain and evidence of pressure on the spinal cord or spinal nerves. The roentgenographic appearance is predominantly that of bone destruction. Rarely there may be some osteoblastic reaction. The arch of the vertebra is usually affected as well as the body. Frequently several adjacent vertebrae show evidence of involvement.

The course of chordoma is slowly progressive, with fatal termination usually within six years. Metastasis may occur but is less common in tumors arising in the vertebrae than in those of sacrococcygeal origin.

Resection of vertebral chordomas is usually not possible because of their location. Symptoms may be relieved by partial resection and laminectomy. Roentgen therapy occasionally offers palliation, but the results have been discouraging.

The authors report a case of chordoma occurring in the third lumbar vertebra and treated by partial excision followed by irradiation.

Four roentgenograms; 5 photomicrographs.

RICHARD P. STORRS, M.D.
Syracuse, N. Y.

A Rare Manifestation of Vertebral Angioma. Sergio Chiappa and Adolfo Sacchi. Ann. radiol. diag. **26:** 105–114, 1953. (In Italian)

During roentgen examination of a 70-year-old woman for possible rib fracture, a characteristic appearance of angioma was discovered in the body of the fifth thoracic vertebral body. The unusual aspect of the process was a soft-tissue mass projecting from the involved vertebra into the right costovertebral gutter, roughly the same size as the knuckle of the aortic arch. This was considered an extension of the angioma beyond the confines of the vertebra. The past history revealed an episode of bilateral lower limb paralysis at twenty years of age. This had been diagnosed and treated as myelitis, and the patient improved considerably. For the past month, however, she had again experienced some disturbances in walking, and neurologic examination revealed a bilateral Babinski sign, active Achilles and patellar reflexes, patellar clonus, and lightning pains in the lower limbs.

A brief review of vertebral angiomas is given. The blood spaces cause practically complete atrophy of the horizontal trabeculae and many of the vertical ones. The remaining vertical trabeculae undergo compensatory hypertrophy. This gives the typical coarsened vertically striped trabecular pattern. The angiomatous foci may be single or multiple, mono- or polyostotic, and may involve part or all of the vertebral body, which may be unchanged, decreased, or increased in volume. The foci may extend into the pedicles and transverse processes, and at times may even extend beyond the confines of the bone. This extension is usually posteriorly into the epidural space, with symptoms of compression upon the spinal cord; rarely, as in the case reported, it may be lateral. These tumors possess some tendency to growth, more marked in youth. Angiomatous formations often coexist in the skin and liver. Cord symptoms are produced either by encroachment of the deformed vertebral body or the angioma itself upon the neural canal. A roentgenologically visible soft-tissue mass has been described only twice before. The differential diagnoses in these rare cases that exhibit a soft-tissue component must include: osteogenic and neurogenic tumors and, most important, tuberculous abscesses. One of the 2 cases previously described, with bilateral soft-tissue extension, had been considered a cold abscess for years. The specific appearance of the bone and the intactness of the intervertebral disks should serve for differentiation.

Three roentgenograms; 3 drawings.

CHRISTIAN V. CIMMINO, M.D.
Fredericksburg, Va.

Chordoma: Its Roentgen Diagnostic Aspects and Its Response to Roentgen Therapy. Edward J. Sennett. Am. J. Roentgenol. **69**: 613–622, April 1953.

Chordomas are rare tumors arising from remnants of the notochord in the vertebral column and clivus. While the occurrence of these rests is frequent, malignant change is infrequent. The material for this paper consists of 11 cases, 1 arising in the clivus, 3 in the cervical spine, 3 in the lumbar spine, and 4 in the sacrum. The patients were from fifteen to sixty-seven years of age, with the majority between fifty-five and sixty-five years. The common feature in the history was the long interval between the onset of symptoms and the first visit to the physician, this period averaging twelve months. Pain was the most frequent symptom. The findings on physical examination varied according to location of the chordoma. When the tumor was situated in an accessible area, a mass was found in each case.

In the case of chordoma of the clivus, radiographs of the skull showed destruction of the dorsum sellae and posterior clinoid as the only changes. Of the patients with chordoma of the cervical area, 1 showed a mass in the tonsillar fossa, while in another instance a mass was palpable in the cervical triangle. All 3 cases of chordoma in the cervical area showed some erosion or definite bone destruction involving the cervical vertebrae. When the chordoma involved the lumbar vertebrae the findings were destruction of the vertebral bodies, a soft-tissue mass, preservation of disk spaces, and subarachnoid block demonstrated by myelography. Sacral chordomas produced expansion of the anteroposterior diameter of the sacrum and irregular destruction of bone without reaction at the margins. With progression of the tumor, the lower half of the sacrum was almost completely destroyed. An associated soft-tissue mass was readily recognized and could be palpated on rectal examination in the hollow of the sacrum.

Eight of the 11 cases of chordoma received roentgen therapy either alone or in combination with surgery. An attempt was made to evaluate the results of irradiation, and it was concluded that it is useful as a palliative measure only in cases in which complete surgical removal of the tumor is impossible.

Thirteen roentgenograms.

RICHARD A. ELMER, M.D.
Atlanta, Ga.

Lesions Producing Bursitis-like Symptoms. Importance of Radiographic Study Before Treatment of Bursitis. John D. Osmond, Jr. Ohio State M. J. **49**: 302–304, April 1953.

The value of roentgen therapy in cases of peritendinitis (bursitis) of the shoulder, hip, elbow, etc., has been so thoroughly established that patients are frequently referred directly for irradiation without roentgenologic confirmation of the diagnosis. Experience has shown, however, that bursitis may be mimicked by a wide variety of conditions. Preliminary films are therefore always indicated. The administration of therapy to unconfirmed cases will not only result in missed diagnoses, but will cast a useful method into ill repute.

Bursitis-like symptoms can be produced by many local as well as distant lesions. Among these the author has found chip fracture of the greater tuberosity of the humerus, posterior subacromial dislocation of the head of the humerus, acute subpectoral abscess, actinomycosis, tuberculous arthritis, osteoarthritis of the cervical spine and/or shoulder joint, giant-cell tumor of the greater trochanter. Other conditions which may simulate bursitis are rupture of the supraspinatus tendon, osteomyelitis, primary or metastatic tumors, and referred pain from cardiac, cholecystic, or pleural disease.

In studying the patient before proceeding with roentgen therapy, no less than two films are taken: with the arm in extreme external rotation and in internal rotation. If the diagnosis is not obvious, additional views are obtained. At least one of the views should be taken on a 10 × 12-inch film, to include the surrounding structures.

The author [as has this abstracter] has noted a very sharp increase in the number of bursitis cases in the past few years. No explanation for this is offered.

MORTIMER R. CAMIEL, M.D.
Brooklyn, N. Y.

Common Injuries of the Musculotendinous Cuff of the Shoulder. Julius S. Neviaser. Bull. Hosp. Joint Dis. **14**: 58–70, April 1953.

The following injuries to the rotator cuff of the shoulder are considered: (1) rupture with a history of injury but no dislocation or fracture; (2) rupture associated with dislocation of the shoulder; (3) rupture with dislocation of the shoulder and fracture of the greater tuberosity. For all of these, anteroposterior and axillary views of the shoulder are recommended as an aid to differentiation.

After the fourth decade degenerative changes occur in the tendons, particularly the supraspinatus, decreasing tensile strength and making the possibility of rupture of the rotator cuff without dislocation or fracture more likely. In such cases arthrography is sometimes helpful. Six to 8 c.c. of radiopaque material is injected under fluoroscopic visualization at the anterior part of the shoulder joint about an inch below the acromioclavicular joint. If the opaque medium runs immediately into the subacromial bursa, one may assume that the patient has a large tear and surgery is indicated.

With fracture of the greater tuberosity, the axillary view is especially important. It shows not only the position of the humeral head, but the relationship of the greater tuberosity in the anteroposterior plane.

Fifteen roentgenograms; 5 drawings.

D. DEF. BAUER, M.D.
Coos Bay, Ore.

Osteoporosis as an Early Symptom of Osteochondrosis Deformans Coxae Juvenilis (Perthes). F. Wirz. Schweiz. med. Wchnschr. **83**: 384–387, April 18, 1953. (In German)

It has been generally believed that osteoporosis is an early roentgen sign of tuberculosis of the hip joint, serving to distinguish it from Legg-Perthes disease. A review of 73 cases of the latter condition has led the author to question this view. Twelve of this group of patients showed the following generally accepted roentgen signs of osteochondrosis deformans juvenilis: (1) widening of the joint space; (2) increased density of the ossification center for the femoral head; (3) cystic rarefactions in the head or neck of the femur adjacent to the epiphyseal plate; (4) broadening of the femoral neck due to periosteal new bone deposition; (5) hypoplasia of both rami of the ischial bone and of the inferior ramus of the homolateral pubic bone with asymmetry of the pelvis; (6) swelling of the periarticular soft tissues due to chronic synovitis.

Nine of these 12 patients showed, in addition, definite localized osteoporosis, though this was less pronounced than the osteoporosis usually encountered in hip joint tuberculosis. The roentgenograms demonstrating this finding were taken during the early course of the disease, within one to five months of the onset of symptoms. Only 4 of these 9 patients had been immobilized prior to the taking of the first radiograph. In 1 case, osteoporosis was the *only* early sign of the disease. In those cases in which immobilization preceded filming, the osteoporosis was nevertheless confined to the affected side. In 1 other case, osteoporosis occurred in the late phase of the disease and was probably the result of structural transformation of bone. In 3 cases Legg-Perthes disease was associated with aseptic necrosis of the ischiopubic synchondrosis.

Eight roentgenograms; 1 diagram.

GERHART S. SCHWARZ, M.D.
New York, N. Y.

Horizontal Lateral Roentgenography of the Hip in Children. A Preliminary Report. Herbert Laage, James C. Barnett, John M. Brady, Peter J. Dulligan, Jr., Herbert C. Fett, Jr., Thomas F. Gallagher, and Bertram A. Schneider. J. Bone & Joint Surg. **35-A:** 387–398, April 1953.

The usual roentgen study of the hip, consisting of an anteroposterior view and a lateral view made with the patient in the "frog-leg" position, constitutes a complete examination of only the head and neck of the femur. On these films the pelvic component of the hip is seen in only a single plane. A horizontal lateral view shows a totally different plane of the pelvis as well as of the proximal end of the femur. Such a projection is of particular value in determining the presence of anterior or posterior displacement after reduction of congenital hip dislocation. A simple mechanical device is used for holding the patient and the film in a position identical to that used for lateral views during hip-nailing surgery.

From this horizontal lateral film, the angle of anteversion of the neck of the femur can also be calculated. Determination of this angle may be of value when rotational osteotomies are being considered and in study of Legg-Perthes disease and slipped capital femoral epiphysis.

Twenty-five roentgenograms; 2 photographs; 1 diagram.

RICHARD P. STORRS, M.D.
Syracuse, N. Y.

A New Method for Determination of Torsion of the Femur. Knox Dunlap, A. R. Shands, Jr., Lucius C. Hollister, Jr., J. Stuart Gaul, Jr., and Harold A. Streit. J. Bone & Joint Surg. **35-A:** 289–311, April 1953.

Torsion is defined as the deformation of a body by twisting, one end being held fast while the other is turned on its length as an axis. In torsion of the femur, the lower or condylar end is held fast while the proximal end is turned. The degree of torsion may be measured by the angle formed by the plane of the central axis of the femoral neck with the plane of the transcondylar or lower-end axis. If the plane of the femoral-neck axis points forward or anterior to the frontal plane, the angle of torsion is designated as a "plus" angle and the condition is referred to as anteversion, antetorsion, or anterior twist. If the plane of the femoral-neck axis points backward or posterior to the frontal plane, the angle is designated as a "minus" angle and the condition as retroversion, retrotorsion, or posterior twist. Femoral torsion is sometimes referred to as the "angle of declination." This should not be confused with the angle of inclination formed by the femoral-neck axis and femoral-shaft axis as seen on an anteroposterior roentgenogram.

The authors review the literature on measurements of torsion in dried specimens of femurs and in patients. Clinical measurements have been considered as difficult and subject to considerable inaccuracy. Accurate measurement of the anteversion frequently associated with congenital dislocation of the hip is held to be important in the treatment and prognosis in such cases.

The authors describe their method of determining the anatomical or true angle of torsion of the femur. With the patient prone and in a neutral position, a posteroanterior film of the pelvis and hips is obtained, on which the apparent angle of inclination of the femur is measured. Lateral roentgenograms of the hips are then made with the patient supine and the lower extremity precisely positioned in an apparatus with an attached radiopaque reference bar. The apparent angle of torsion is measured on this film. The true angle of torsion is determined from the apparent angles of measured torsion and inclination with the use of a graph prepared from a trigonometric formula. The authors report studies made with this method on patients with various hip abnormalities, and observations as to the accuracy of the method and sources of error.

Six roentgenograms; 11 photographs; 4 graphs; 2 tables.

RICHARD P. STORRS, M.D.
Syracuse, N. Y.

Measuring Femoral Anteversion: The Problem and a Method. Charles T. Ryder and Lawrence Crane. J. Bone & Joint Surg. **35-A:** 321–328, April 1953.

The anteversion angle of the neck of the femur is of interest, particularly in its relation to such conditions as congenital dislocation of the hip. The authors describe a method of measuring femoral torsion or anteversion based on geometrical principles. The method involves four steps: (1) An anteroposterior roentgenogram is made with the femur in neutral position. (2) A second roentgenogram is made with the hip and the knee flexed 90 degrees and the thigh abducted 30 degrees. (3) The angle made by the axis of the femur with the shaft axis is measured on the first film. (4) The angle made by the axis of the neck and the transcondylar plane is measured on the second film. The true angle of anteversion is then determined from the measured angles by use of a graph or table.

The authors describe a frame which they use in positioning the patient for the abduction roentgenogram.

Errors may result from inaccurate positioning of the patient and inaccurate location of the axes on the roentgenograms. The authors believe that if the method is carried out carefully, the error in anteversion determination from positional mistakes should rarely be as much as 15 degrees.

Two roentgenograms; 6 photographs; 1 table; 1 graph.

RICHARD P. STORRS, M.D.
Syracuse, N.Y.

Malignant Sympathetic Neuroectodermal Tumor. Solomon R. Bersack and Hugo V. Rizzoli. Am. J. Surg. **85:** 564–574, April 1953.

The authors report under the above title a case formerly reported as a malignant paraganglioma (Young,

V. T.: Am. J. Surg. **76**: 748, 1948). They quote Willis (Pathology of Tumours. C. V. Mosby Co., 1948) as doubting the existence of this latter type of neoplasm. The patient, a man of 31 years, had experienced pain in the coccygeal region for twelve years. He had a hard, fixed mass bulging into the posterior rectum which at operation was found to be quite extensive. It involved the ischiorectal fossae, and was adherent to the sacrum for 10 cm. Subsequently, widespread metastatic disease developed, with death three years later.

Roentgenologically, there was widespread bone involvement with osteoblastic, osteolytic, and mixed lesions throughout the spine and pelvis. Several of the vertebral bodies were ivory in appearance. Initially some of the metastases in the vertebral bodies were confused with osteomyelitis. There was an osteoblastic metastasis to the right frontal bone, with radiating spicules characteristic of neuroblastoma. On three occasions, intraspinal metastases of the dumb-bell type were demonstrated and two of these were partially removed.

The authors postulate that the patient had a tumor of neuroectodermal origin with widespread metastases rather than multicentric tumors. They quote Lewis and Geschickter and their conclusion that neuroblastomas, paragangliomas, and ganglioneuromas have a common origin, each being the result of a different degree of differentiation. Until the potentiality for malignancy of paragangliomas has been determined, the authors suggest the non-committal term of malignant sympathetic neuroectodermal tumor.

Eleven roentgenograms; 5 photomicrographs.

M. HARLAN JOHNSTON, M.D.
Jacksonville, Fla.

GYNECOLOGY AND OBSTETRICS

The Helicoid Uterus. B. H. Sheares. J. Obst. & Gynaec. Brit. Emp. **51**: 175–179, April 1953.

The uterus has been shown to be constructed of two spiral systems of muscle bundles—originally the müllerian ducts—which fuse in concentric interlacing circles to form the adult pattern of uterine musculature. While the assumption has been that the müllerian ducts meet exactly in the mid-line and that the uterus is invariably positioned dead centrally, x-ray studies of a large number of patients have shown that this is not invariably so. Among 134 anomalies of the genital tract observed in 29,726 patients, there were 48 examples of spirally asymmetrical uterus, to which the author applies the term "helicoid." These were discovered by bimanual examination under anesthesia and by roentgen study. Of the 22 cases examined radiologically, 3 were subsequently confirmed at laparotomy. The anomaly apparently has a direct relationship to infertility.

In a further study of 803 uteri examined postmortem, there were 51 of the helicoid type, associated in 7 cases with some other abnormality of the genital organs.

An explanation of this anomaly based on geometric and mechanical principles is offered and it is concluded that the spiral twist and asymmetry of the helicoid uterus are attributable to inequality in the rate of growth of the two müllerian ducts, for in this type of uterus one-half is better developed than the other, and this better developed portion is invariably anterior to the other. Besides this spiral twisting on the longitudinal axis, there is also an element of deviation, either an exaggeration of anteversion or retroflexion or a lateral deviation.

Four roentgenograms; 13 photographs; 3 tables.

The Determination of the Placental Site by Soft-Tissue Radiography. A. S. Whitehead. J. Fac. Radiologists **4**: 245–263, April 1953.

Historically amniography was the first technic employed for radiological location of the placental site. Its obvious disadvantages are the hazards of induction of labor, introduction of infection, injury to the fetus, damage to the umbilical vessels, separation of the placenta, etc. The procedure, however, allows an exact delineation of the placental outline and for that reason was used in 20 cases in the present investigation to make sure that the particular shadow interpreted as placenta on soft-tissue radiography was actually due to that organ. It was also of aid in the interpretation of the various other outlines obtained by the soft-tissue technic.

Most of the other measures which have been employed for placental localization have technical disadvantages and dangers obviating their routine use. Soft-tissue radiography offers a convenient, safe, and simple method of evaluating the placental site, with the added advantages of consistency and accuracy.

The material upon which the present study was based consisted of 424 pregnant women examined radiologically at Mill Road Maternity Hospital, Liverpool, between January 1949 and March 1952. The patient's bladder and rectum were emptied, when permissible, and two films were taken routinely: (1) an erect lateral view of the pelvis and a lateral view of the abdomen with the patient recumbent. In special circumstances, right and left posterior oblique abdominal views and a postero-anterior or anteroposterior view in the prone or supine position were obtained. If the patient cannot stand, she may be tilted upright to the maximum degree possible, for a lateral view of the pelvis.

Bucky technics were employed, with a minimum target-film distance of 4 inches. A special aluminum filter was used after preliminary trials with an aluminum "step-wedge." By trial and error the steps were adjusted until satisfactory filtration was achieved, in lateral films of the abdomen. The thick part of the filter was arranged toward the patient's back and the filter was held to the tube casing by the radiographic cone. The advantage of applying filtration close to the anode is that the radiograph shows only the effects of filtration and no confusing shadows from the filter's own structure.

The author presents a detailed discussion of difficulties encountered in interpretation of the lateral radiograph of the abdomen, and the paper should be consulted in the original for a full appreciation of factors influencing the identification of the placenta. The oblique views are of value only when the placenta lies on the lateral uterine wall. It is stated that, contrary to published figures, the placenta does not usually face the ventral surface of the fetus but rather more commonly faces the fetal side. Frontal projections were therefore of little use. The erect lateral view of the pelvis reveals definite identifiable shadows of the lower uterine segment which are of value in the study of placenta praevia.

The placenta was located radiologically in 417 cases, as listed in the accompanying table, and findings were confirmed in over 150 cases. In the remaining cases

SOFT-TISSUE RADIOGRAPHY FOR PLACENTAL LOCALIZATION: 417 CASES

Presentation	Head	Breech	Transverse and Oblique Lies
Total cases	262	104	51
Anterior placenta	112	21	22
Posterior placenta	113	13	6
Anterior lateral placenta	5	1	1
Lateral placenta	4	0	0
Fundal placenta	3	15	10
Fundal cornual placenta	0	52	0
Anterior placenta praevia	8	2	7
Posterior placenta praevia	17	0	5

clinical findings did not suggest any error. The following conclusions are reached:

"1. In head presentations the distribution of the placental site is almost equally divided between the anterior and posterior uterine walls. Only a very small number of cases show lateral or fundal implantation.

"2. In breech presentation there is a marked change, in the distribution of the placental site. The number of implantations in the fundal region is considerably increased and this is especially so where one or other cornu of the uterus is covered. . . .

"3. Transverse and oblique lies are commonly associated with implantation of the placenta in the lower uterine segment or fundus. . . . Anterior implantation in the upper uterine segment is more than three times as common as posterior implantation in transverse or oblique lies."

Clinical follow-up in 376 cases where placenta praevia was excluded revealed no known error. In 45 cases with roentgen evidence of placenta praevia the diagnosis was confirmed clinically in 38 and refuted in none.

Twenty-two roentgenograms; 4 sketches; 4 photographs; 2 tables.

JOHN F. RIESSER, M.D.
Springfield Ohio

A Simple Method of Roentgen Pelvimetry. Robert W. Curry. Am. J. Roentgenol. **69:** 638–646, April 1953.

The author describes a method for measurement of the transverse diameters of the pelvis utilizing a target-film distance of 5 feet, the theory being that with this distance the divergent distortion of the diameters becomes relatively constant and the possible error in the measurement of the actual dimensions is so slight that it is of no clinical importance. The technic is simple and economical. A single anteroposterior roentgenogram is required, and all measurements can be taken directly from the wet film without resort to calculations, charts, nomograms, or body measurements.

Experiments were carried out in which a wire loop 12.9 cm. in diameter was radiographed at varying object-film distances to simulate the greatest possible variation in the degree of magnification of the pelvic inlet at the 5-foot target-film distance. The results of this experiment indicate that the greatest possible error in measurement is less than 3 mm.

For sagittal pelvic measurements, an erect lateral film is obtained, with a perforated lead ruler placed in the gluteal folds. The target-film distance is 3 feet. The measurement of the sagittal diameters is made on the film and corrected by the perforated ruler.

For the transverse pelvic measurement at 5 feet, with the patient supine, the exposure is three times as great as for ordinary pelvimetry at a distance of 3 feet. The transverse diameter of the pelvic inlet and the interspinous diameter are read directly from the film by means of a calibrated scale.

Seven illustrations, including 4 roentgenograms; 6 tables.

J. L. CLEMENTS, JR., M.D.
Atlanta, Ga.

The Value of the Lateral Pelvic Roentgenogram as an Index of Fetal Maturity and Type of Maternal Pelvis. J. Bay Jacobs. Am. J. Obst. & Gynec. **65:** 897–905, April 1953.

The author advises pelvimetric roentgenography as late in pregnancy as possible. He recommends the lateral standing study. The erect posture favors engagement of the presenting part and permits a good appraisal of cephalopelvic relationship, and the lateral view affords a better demonstration of the architectural features of the pelvis and fetal skull.

The object of the study here reported, based upon 1,860 cases, was to determine whether the biparietal diameter lends itself to accurate mensuration often enough, and whether its length as an index of fetal maturity is reliable enough, to be of practical value in making the important decisions which so commonly confront the obstetrician. It was found that in 2 out of 3 cases examined the biparietal diameter engages in the true conjugate, permitting accurate measurement in the lateral study. It was further determined that, unless it is definitely abnormal, the contour of the inlet does not affect the manner of engagement of the fetal skull.

In 761 cases the weight of the fetus at birth was known as well as the period between x-ray study and delivery. Plotting these figures against the biparietal diameter, the author obtained a graph which is useful in forecasting both fetal maturity and birth weight.

Four roentgenograms; 1 graph; 1 table.

MASON WHITMORE, M.D.
Jefferson Medical College

The Intra-Uterine Growth of the Foetal Head After the 36th Week of Pregnancy. Derk Crichton. J. Obst. and Gynaec. Brit. Emp. **51:** 233–236, April 1953.

The author assessed the growth of the fetal head after the thirty-sixth week of pregnancy by comparing the intra-uterine and post-natal lengths of (1) the biparietal diameter, (2) the occipito-frontal diameter, and (3) the average cranial circumference (that is, the average of two circumferences at 90° relationship to each other. These measurements were carried out in 68 patients, and the infants, delivered not less than two weeks later, were subjected to radiologic cephalometry seventy-two hours after birth. This study was prompted by the startling pronouncement of Josephs (Brit. M. J. **2:** 1440, 1949. Abst. in Radiology **55:** 789, 1950) that "there is no sign of a growth curve between the thirty-sixth and fortieth week of pregnancy."

As a result of the present study, it is concluded that the rate of growth of the biparietal diameter after the thirty-sixth week is about 0.1 to 0.12 cm. per week. The occipito-frontal diameter increases at the rate of 0.11 cm. per week, and the average cranial circumference enlarges by 0.3 cm. per week. Growth continues, but the rate is lessened to a minor extent, after the fortieth week of gestation.

The variability in rate of growth of different diameters in the same skull is attributed to the resistance encountered in some directions. Growth may even cease in one direction, with compensatory increase in others. Thus it is even possible for the biparietal diameter to decrease after the thirty-sixth week. Those diameters which fail to grow or grow at an abnormally slow rate are less capable of molding in labor.

One roentgenogram; 3 tables.

THE GENITOURINARY SYSTEM

Urethrography in the Male with a Highly Viscous, Water-Soluble Contrast Medium, Umbradil-Viscous U. Olallo Morales and Ragnar Romanus. Acta radiol. Supplement 94, 1952.

In a Supplement to *Acta radiologica* an evaluation of a highly viscous water-soluble contrast medium for use in urethrography is presented with the usual thoroughness characteristic of these publications. The laws of hydrodynamics are applied to micturition in normal and pathologic conditions and the results of examination with the medium are explained in this light.

A total of 83 cases were examined, concurrently, with both high- and low-viscosity agents under fluoroscopic control. Films were taken in several projections and an effort was made to evaluate the two media by comparing such details in the reproductions as distinctness of contour, degree of distention of the urethra, visualization of strictures, filling of the paraurethral ducts, and alterations in the bladder neck and bladder.

Urethrographic interpretation errors as seen with different contrast preparations and technics are considered and the possibilities of avoiding these pitfalls are discussed.

The authors reach the following conclusion: "Urethrography of the male urethra is best accomplished with the water-soluble, highly viscous preparation, Umbradil-Viscous U with fluoroscopic control. This preparation contains a urographic contrast agent in relatively high concentration, a non-irritating viscosity-increasing agent (to provide a consistency similar to table syrup), and a rapidly acting anesthetic agent. The pictures are most satisfactorily made (using four projections including a 90-degree lateral) during injection, voluntary contraction of the pelvic floor immediately following discontinuation of injection, and, if possible, during micturition."

Mucous membrane anesthesia should always be used for the patient's comfort and to reduce the possibility of reflex muscle contraction.

Eighty-four roentgenograms; 4 drawings.

C. J. La Vielle, M.D.
Henry Ford Hospital

Contrast Media for the Kidneys, Heart and Vessels, and Their Toxicity. Carl Sandström. Acta radiol. **39**: 281–296, April 1953.

The author refers to a number of the more recent contrast media, including Uroselectan B, Abrodil, Perabrodil, Hippuran, and Urokon. Though these represent an improvement over some of the earlier contrast substances, they are still not entirely non-irritant and may produce secondary symptoms. Originally intended for the urinary tract, they are now used during examination of other organs such as the cardiovascular system, in which a greater amount of material is usually injected, more rapidly. Consequently, the risk of side reactions has increased.

A suitable contrast medium should (1) have the largest possible opacity to roentgen rays, (2) be water-soluble and correspond to the pH of the blood, (3) be completely inert and thus have no toxic effect, and (4) be a single, chemically well defined, stable substance.

Following a consideration of the organic iodine compounds now in most frequent use, with a review of reports on their employment and the untoward reactions observed, the author presents his own material—80 cases in which angiocardiography was done with Umbradil and its derivatives in doses up to 80 ml. 70 per cent solution: 9,897 urographic studies, including (1) an early series of 4,930 cases in which a variety of media were used, (2) 100 with Dijodon D (Benadryl and Diodrast compound solution), and (3) 4,867 with Umbradil (35 per cent) in doses of 20 to 40 ml.

No injurious secondary effects were observed in the 80 angiocardiographic studies.

In the early series of urographic examinations there were 20 cases of serious side effects but no fatalities. It is believed that in a few instances the reactions were probably not due to the contrast medium but to the considerable degree of compression exerted on the abdomen in order to obtain better filling of the kidney pelvis.

In the last urographic group, with Umbradil, serious reactions occurred only twice and in both instances yielded promptly to treatment. This medium is considered highly satisfactory.

In the small Dijodon D series there were 3 reactions. Though all 3 patients recovered, the author does not advocate the use of this medium. Not only did he fail to obtain encouraging results, but there is no theoretical reason for its employment.

The following recommendations are made for the prevention and treatment of side reactions. (1) Slow (two to three minutes) injection of the medium; (2) in case of urticaria, laryngospasm, etc., 10 c.c. of calcium gluconate intravenously and intramuscularly; (3) in case of hypotension, weak pulse and cold perspiration, discontinuance of abdominal compression and, if necessary, 1 c.c. of Ephedrin intravenously and intramuscularly; (4) oxygen if symptoms are severe and persistent; (5) calcium gluconate for muscle twitchings or, in severe cases, a soluble barbiturate by vein.

One table, listing chemical formula, official name, iodine content, and trade names of various media.

James H. Grove, M.D.
Mt. Sinai Hospital of Cleveland

The Influence of Diphenhydramine (Benadryl) on the Side-Effects of Diodone in Urography. Ejnar Gilg. Acta radiol. **39**: 299–307, April 1953.

Accepting the theory that hypersensitivity is the cause of most of the side-effects of Diodone, the author believes that some of these complications might be counteracted by antihistamine drugs. He investigated the effects of a preparation called "Diodone cum Diphenhydramino" (equivalent to Diodrast containing 20 mg. of Benadryl per dose), which has been used for urography. The side-effects noted in a group of 416 patients in whom this preparation was used were compared with those in a control group of 296 in which Diodone alone was used.

It is stated that there was a significant decrease in the incidence of subjective sensation of heat, flushing of the face, and nausea and vomiting in the group which received the Benadryl preparation. However, the in-

cidence of urticaria was not reduced. Approximately 2.8 per cent of the patients who received the Benadryl compound complained of drowsiness. There appeared to be a smaller and less frequent drop in blood pressure.

The author concludes (1) that the preparation is equal to others as a contrast medium; (2) that it is less likely to produce minor side-effects but that severe reactions, including urticaria, are not reduced in number; (3) that the antihistamine content appears to counteract in some degree the decrease in blood pressure; (4) that the possibility of hypersensitivity to the Benadryl itself should be taken into account.

For a more unfavorable view of this medium see the preceding abstract.

Two diagrams; 2 tables.

ALVIN J. GREENBERG, M.D.
Mt. Sinai Hospital of Cleveland

Roentgenological Aspects of Renal Function. Hugh M. Wilson. Yale J. Biol. & Med. **25:** 401–404, April 1953.

Although some tubular secretion may occur, excretion of Urokon is effected chiefly by glomerular filtration. Diodrast, also, is excreted as a glomerular filtrate as well as by tubular secretion. The contrast medium becomes concentrated by tubular absorption of water. The amount of Diodrast filtered through the glomeruli is directly proportional to plasma concentration, but the factors controlling tubular excretion are more variable. Extensive studies carried out on renal clearance of Diodrast indicate that, with the single injection technic of intravenous pyelography, the density of the contrast medium in the renal pelvis is produced primarily by glomerular filtration.

The routine use of dehydration prior to intravenous pyelograms sometimes decreases urine flow to a point where small pelves and collecting systems are not well visualized. Controlled hydration by giving water to a dehydrated patient one hour prior to intravenous injection of concentrated contrast medium has been shown to improve the shadows of small renal pelves by insuring adequate urinary output during the examination.

Concentrated contrast media appear in the collecting system of normal kidneys in three minutes. Following rapid injection of 50 c.c. of concentrated Urokon (70 per cent), one sees an immediate dense nephrogram, which begins to fade as the material appears in the collecting system. It is felt that the nephrogram is produced by contrast medium within the capillary network of the functioning renal parenchyma. However, the increased density of the renal shadow which persists throughout the routine serial films is probably produced largely by the presence of the glomerular filtrate in the collecting tubules.

DEAN W. GEHEBER, M.D.
Baton Rouge, La.

Investigations on Backflow in Retrograde Pyelography. A Roentgenological and Clinical Study. Rolf Köhler. Acta radiol., Supplement 99, 1953.

Much of the work on backflow in retrograde pyelography has been done on cadavers and in animals. The author's study is based solely on clinical material. Specifically, the pressure at which backflow occurs, the roentgen anatomy of backflow, possible injurious effects, and importance from a diagnostic point of view were investigated.

Among 628 retrograde pyelographic studies (321 bilateral), there were 154 cases of backflow. An additional 27 cases were experimentally investigated with regard to pressure conditions coinciding with backflow. For this latter study a No. 6 Charrière catheter in the ureter was connected to a manometer and the examination was conducted at increments of 20 mm. up to 100 mm. Hg pressure and at 150 and 200 mm. All cases in which leakage into the ureter had occurred were excluded, since even a small leakage is apt to distort the results, particularly at the higher pressures. In 14 cases, backflow occurred with pressures between 80 and 100 mm. Hg. Three cases withstood pressure of 200 mm. Hg without backflow. Pain was considerable at 80 mm. Hg pressure and severe at 120 mm. The patients without backflow at 200 mm. Hg were without pain at that level. The margin between pain sensation and backflow is thus too narrow to avoid the latter in most instances. Sinus extravasation was present in 10 cases and tubular backflow occurred in 7 cases at low-pressure levels. No pyelovenous backflow occurred at these levels. The higher-pressure mixed backflows, consisting of tubular, sinus, and lymphatic components were the rule.

Venous backflow is probably clinically very rare. This question was studied with concentrations of fluorescein sodium mixed with the contrast medium.

The clinical significance of backflow was studied by means of roentgenograms in normal and common pathogenic states.

The frequency of backflow in the presence of hydronephrosis and renal infection was found to be approximately the same as in patients with clinically normal kidneys. All backflows in hydronephrosis, however, were of tubular type. Degenerative renal changes, with an increase of connective tissue, frequently made the occurrence of backflow more difficult.

The danger of backflow was estimated and was considered slight, since there was no significant difference in rise in temperature or other clinical findings in the cases observed.

Backflow may cause difficulty in differential diagnosis. Especially is this true of small contrast extravasations near the calyces, such as occasionally occur in tuberculous papillary ulceration. In cases of suspected traumatic rupture of the kidney and in those in which a catheter might have produced a rupture of the pelvis, possible backflow must be considered.

This monograph places on a factual basis the ideas concerning the incidence and levels of pressure necessary to produce commonly experienced backflow in retrograde pyelography.

DAVID C. GASTINEAU, M.D.
Indiana University

Presacral Perirenal Pneumography. Laurence F. Tinckler. J. Fac. Radiologists **4:** 268–274, April 1953.

The retroperitoneal organs have been visualized radiologically by several different methods over a period of many years. Delineation of the adrenals has been especially difficult. Pneumoperitoneum and direct perirenal insufflation have met with some success. Abdominal aortography has also been of value. Because of the relative simplicity of the presacral approach for retroperitoneal air insufflation, the author reports his experiences with that technic in 36 consecutive cases. The method is termed, after Blackwood (Brit. J. Surg. **39:** 111, 1951. Abst. in Radiology **59:** 294, 1952), "presacral perirenal pneumography."

The technic followed is that described by Blackwood. After the injection, films are taken (Bucky technic) in the anteroposterior, postero-anterior, and lateral projections, with the patient supine and upright. Tomography may be used in difficult cases. Manipulation and exercise may be employed to redistribute air before making further films to clarify doubtful shadows.

Several diagnostic points are suggested by this study. The ease with which air permeates through the tissues and around the kidneys suggests that the fascial sheath of Gerota is not closed below the kidney. Whether or not this is true has previously been a matter of anatomical conjecture. In the case of malignant lesions such as retroperitoneal lymphosarcoma, the shadow of the kidney, which is normally present, will be obliterated due to infiltration of the soft tissues. Cysts of the kidney and hypernephromas will show characteristic outlines, while inflammatory lesions involving the capsules of the kidney will, like cancer, obliterate the air space. Tumors of the adrenal can be localized and distinguished from simple hyperplasia of the glands. With the development of partial adrenalectomy in treatment of hypertension and the adrenogenital syndrome, it is reassuring to be able to demonstrate the presence of the adrenal on both sides by a relatively simple method.

Four brief case abstracts are presented.

Nine roentgenograms; 1 photograph.

JOHN F. RIESSER, M.D.
Springfield, Ohio

A Study of the Renal Tract in Carcinoma of the Cervix. Ruth Dearing. J. Obst. & Gynaec. Brit. Emp. **51:** 165–174, April 1953.

A study of the renal tract was made in 428 patients with carcinoma of the cervix. The majority were treated by radium or a combination of radium and surgery. Three hundred and twenty-seven pretreatment pyelograms were available for study, and of these 264 were obtained at least a year before the present analysis of the relation of the findings to prognosis. Of 189 patients with normal pyelographic findings, 60 (31.7 per cent) died within the first year following treatment; of 75 with abnormal findings (hydronephrosis; hydroureter; failure of excretion; poor concentration of the medium), 53 (70.0 per cent) died in the first year. Correlation of these findings with clinical observations indicates that an abnormality in the pyelogram of a patient with carcinoma of the cervix is a sign of very grave significance irrespective of the clinical advancement of the tumor. Although these abnormalities tend to be seen more frequently in patients with advanced tumors, the frequency with which they are seen in those suffering from clinically less advanced tumors is not inconsiderable.

It was found on histologic studies made possible by operation and autopsy that the renal abnormalities observed may result from extension of the tumor into the broad ligament or involvement of the lymph nodes. This latter event is more frequent than has hitherto been thought. In some cases infiltration of the periureteral lymphatics is the cause of the abnormality. There were significantly more abnormalities of the urinary tract in cases which were resistant to irradiation.

In view of the above observations, the author concludes that, since the results are so poor in all types of cases in which the pyelogram is abnormal, some patients might be considered for pelvic exenteration on the grounds of an abnormal pyelogram when otherwise the clinical extent of the disease would not suggest this procedure. No doubt many cases with extensive lymph node involvement would be found in this group, but some at least might be given a chance of survival which they otherwise may not have had. Finally, if use is to be made of the pyelogram in the follow-up of treated patients, it is essential to have a pretreatment radiograph for purposes of comparison.

Repeat pyelograms were obtained a year after treatment on 69 patients in whom the pretreatment findings had been normal. These indicated strikingly the grave prognostic significance of an abnormal pyelogram following therapy. Of 40 patients with normal findings, 3 had died (7.5 per cent), while of 29 with abnormal findings, 21 (72.4 per cent) had died. Three of the total of 24 deaths were from radium necrosis. The value of post-treatment pyelography would thus appear to be twofold: first for the early detection of changes due to radium necrosis and second to obtain evidence of recurrence, which would be useful in planning further treatment.

Four roentgenograms; 3 photomicrographs; 10 tables.

Retroperitoneal Tumors in Children. Roentgen Diagnosis. Howard L. Steinbach and Reynold F. Brown. California Med. **78:** 263–266, April 1953.

Fifteen cases of proved Wilms' tumor and 14 of neuroblastoma in which adequate roentgen examination had been carried out were studied. The age range was three days to ten years, with similar spreads, with an average of two and a half years for Wilms' tumor and three years for neuroblastoma.

Calcification was observed in 2 of the Wilms' tumors (12 per cent) and in 8 of the neuroblastomas (57 per cent). The average age of patients with calcified neuroblastoma was three years; for those without calcification it was a year and three-quarters. The calcification in the 2 Wilms' tumors was peripheral, consisting of dense, homogeneous, concentric rings. In 6 of the neuroblastoma cases the calcification was stippled or flaky, and in 2 dense and well circumscribed.

The kidney was frequently displaced. The neuroblastoma always displaced the kidney downward, or downward and slightly outward. In most instances, the Wilms' tumor also caused displacement downward and outward, but in some cases upward and medially. This, of course, depended upon the site of origin of the tumor.

Urograms were obtained in 10 patients with neuroblastoma and in all with Wilms' tumor. In all of the neuroblastoma group there was function of the kidney on the involved side; 6 patients showed evidence of distortion of the intrarenal structures. In 4 of the 17 Wilms' tumors (2 cases were bilateral) there was no roentgen evidence of function of the involved kidney. In 10 of the 13 with adequate function there was intrarenal distortion.

Two roentgenograms; 3 drawings.

ARTHUR S. TUCKER, M.D.
Cleveland Clinic

Renocolic Fistula. Report of a Case. John D. Briggs and Roderick M. Neale. J. Urol. **69:** 484–486, April 1953.

Renocolic fistula is a rare complication of renal stones and infection. In a review of the literature no cases

were found secondary to cancer or to infection originating in the colon.

In the case reported, there was a history of pain and tenderness in the left kidney area occurring intermittently for twenty years. Excretory pyelography revealed a staghorn calculus and absence of function of the left kidney. Barium enema study showed a fistula in the descending colon, but the connection with the kidney was not demonstrated with certainty. The left ureteral orifice could not be seen, preventing retrograde examination.

At surgery the kidney and adjacent adherent bowel were removed together and complete recovery ensued. This is the treatment of choice when the diagnosis is known, since in the cases previously reported poor results usually followed more conservative surgery.

One roentgenogram; 1 photograph.

ZAC F. ENDRESS, M.D.
Pontiac, Mich.

THE BLOOD VESSELS

A New Technique of Venography of the Lower Extremities with Urokon. William H. Boyce, John H. Detar, and Samuel A. Vest. Surg., Gynec. & Obst. **96**: 471–481, April 1953.

The contrast substance, 70 per cent Urokon, is miscible with blood but has a higher specific gravity, which results in gravitation of the medium down a dependent vein and opposite the blood flow, to the first competent valve. Traditionally, contrast medium is injected into a peripheral vein at a point distal to the site of suspected disease. The authors have devised a method of proximal injection and depend upon the gravitational effects for visualization of the veins of the pelvis and lower extremities.

The patient is placed in a supine position with the head of the table elevated 15 degrees and the bony pelvis centered on a 14 × 17-inch film. Fifty cubic centimeters of the 70 per cent Urokon is injected into the superficial dorsal median vein of the penis, with a 21 or 23 gauge needle. The total time for injection is one and a half to three minutes, and the exposure is made as the injection is completed. This resulted in bilateral filling in about half of a series of 78 normal males (54 per cent). In the remaining cases a second injection of 25 c.c. was made into the superficial lateral vein of the penis on the side which failed to be visualized. In females, bilateral filling cannot be obtained, but unilateral filling is achieved by the injection of 25 c.c. into the superficial circumflex iliac or any other superficial vein which empties into the saphenous or deep femoral vein in the thigh.

Venograms of the complete thigh and lower leg may be obtained by the proximal injection technic only when superficial or deep venous incompetence is present. With the patient semi-erect, the medium is introduced into the median superficial or lateral superficial vein of the penis. Under these conditions the Urokon gravitates to the level of the first competent valve of the femoral vein. The large profunda femoris vein is without valves at the point of juncture with the femoral vein and is visualized in 97 per cent of normal individuals. Normally, the Urokon does not migrate beyond the superior or first competent valve, which is usually present in the upper third of the femoral vein. The presence of contrast medium below this valve is evidence of incompetency in the deep system.

Among the 94 patients in this series, there were no serious untoward reactions. Two patients vomited; several noted transient sensations of nausea; 22 complained of pain at the site of the injection; 2 had large hematomas at the site of the injection; and 3 suffered extravasation of the material into the subcutaneous tissues.

The authors were able to demonstrate vascular incompetence and chronic and acute venous obstruction. They claim for the proximal technic the following advantages; (1) It is simple. (2) It reveals physiologic states of valvular competence not demonstrable by the traditional technics. (3) The main trunk of the profunda femoris vein will be visualized, an achievement not consistently duplicated by the distal method. (4) The danger of dislodging an embolus is said to be less. Bilateral venograms of the femoro-iliac veins are important diagnostic aids in suspected venous thrombosis or pulmonary embolism of unknown origin.

Urokon is considered superior to any other available contrast medium. [This may be so, but there is nothing in the article to support this claim, and it should be accepted simply as the personal opinion of the authors.—M. R. C.]

Twenty-one roentgenograms.

MORTIMER R. CAMIEL, M.D.
Brooklyn, N.Y.

Renal Arteriography. Report of a Percutaneous Method Using the Femoral Approach and a Disposable Catheter. E. Converse Peirce, 2nd, and William P. Ramey. J. Urol. **69**: 578–585, April 1953.

Still another method of injecting contrast medium into the aorta near the renal artery orifices is presented, with the object of making the procedure safer and less complicated.

Percutaneous puncture of the femoral artery is performed with a large-bore needle. Through this is passed a polyethylene catheter to the desired level and the injection is then made. Excellent films are reproduced. The authors report only 1 failure to get the catheter to the proper level in 26 patients.

The simplicity of the technic and the safety it affords the patient are the chief advantages of the method. Fewer people are required, only local anesthesia is needed, and the operator gets much less x-ray exposure. Hematoma formation is usually obviated by pressure; arterial damage has not been encountered. One case of arteriovenous fistula was seen (between the femoral and a branch of the saphenous).

Five roentgenograms; 1 photograph; 1 table.

ZAC F. ENDRESS, M.D.
Pontiac, Mich.

Splenic-Portal Venography. A Technique Utilizing Percutaneous Injection of Radiopaque Material into the Spleen. Henry T. Bahnson, Robert D. Sloan, and Alfred Blalock. Bull. Johns Hopkins Hosp. **92**: 331–345, April 1953.

A method of demonstrating the portal venous system by injecting an opaque medium into the spleen is described. Twelve to 40 c.c. of 70 per cent Diodrast is injected percutaneously into the spleen as rapidly as possible, and serial films are obtained at the rate of one per second, starting toward the end of the injection. There is almost immediate opacification of the splenic vein, followed within two or three seconds by filling of

the intrahepatic portal branches. After approximately five seconds, the opacification of the portal system begins to decrease rapidly.

This technic was used to examine the portal venous system in 6 patients—without complications. The method has proved to be of value in determining the site of obstruction in the portal venous system. It has facilitated subsequent operative procedures, because the surgeon has had information concerning the condition of the portal veins before operation.

Ten roentgenograms.

HOWARD L. STEINBACH, M.D.
University of California

X-Rays Findings in Kaposi's Angiomatosis (Sarcoma Idiopathicum Haemorrhagicum Multiplex). G. Bonse and R. Karg. Fortschr. a. d. Geb. d. Röntgenstrahlen **78:** 456–460, April 1953. (In German)

Kaposi's angiomatosis is regarded by the authors as a special form of angiomatosis with vessel dilatation, fibrous stroma, and pigmentation. The type of individual lesion depends largely on the predominance of changes in the vessels or fibrous stroma. There may therefore be a resemblance to hemangioma, lymphangioma, or fibroma.

Most cases in the early stages show involvement of the lower extremities with fairly symmetrical distribution on both sides. The lesions appear to follow the course of the vessels and spread proximally. In the later stages there is generalized involvement, including practically all tissue structures and organs, especially the lungs, bladder, and intestines. In many cases there is a severe anemia. The blood picture is not characteristic, but monocytosis and eosinophilia are frequently found. Death occurs, with a high grade of cachexia.

X-ray studies, particularly with soft-tissue technic, show the characteristic changes in the deeper layers of the skin, with diffuse vessel dilatation and a knot-like, mushroom type of tissue proliferation, but phleboliths have been observed in very few cases. Skeletal changes consist of periosteal reactions, atrophy, and demineralization, cystic changes within the bones, and eventual complete disruption of structure. Occasionally enchondromatosis is associated, and it is believed that there may be a pathological relationship between the two conditions. Roentgen changes in the inner organs can usually be identified only by correlation with the skin changes, as the lesions in these structures are not characteristic from a radiologic standpoint.

Four roentgenograms; 1 photograph.

E. W. SPACKMAN, M.D.
Fort Worth, Texas

RADIOTHERAPY

Cerebellar Medulloblastoma: Treatment by Irradiation of the Whole Central Nervous System. Edith Paterson and R. F. Farr. Acta radiol. **39:** 323–336, April 1953.

The authors describe 27 proved cases of medulloblastoma treated between 1941 and 1950 by irradiation of the brain and entire cord as an undivided unit. Twenty-two of the patients were children from fourteen months to thirteen years of age. Treatment is given through a single spade-shaped posterior field, at a long focal-skin distance. To obtain the narrow spinal cord field a lead protective table is used, with a central slot. The dosage rate at anatomical points is measured for each case in a Presdwood phantom shaped to follow the contours of the patient. The minimal tumor spinal doses prescribed have been 3,000 r over three weeks or 3,500 r over a five-week period. Supplementary radiation by paired, angled anterior fields is required to raise the dose to the minimum figure throughout the head. Minimum recommended doses to the head are 3,500 r over five weeks or 3,000 r over a three-week period to a point 1 cm. anterior to the floor of the fourth ventricle, as determined by the method of Twining (Brit. J. Radiol. **12:** 569, 1939). The authors suggest that a dose somewhat higher than this may give better results and that the aim should be 4,000 r.

The three-year results of treatment are as follows:

	Treated	*Alive*
Children and adults.....	17	11 (65%)
Children only.....	13	7 (54%)

Five of 7 patients treated had survived for five years at the time of this report. Of the 11 surviving three years or longer, 1 had severe optic atrophy and blindness. Presenting ataxia disappeared completely in the children but persisted slightly in 2 adults. Some interference with vertebral growth may occur due to irradiation effects on spinal epiphyses. Two deaths occurred during treatment. In 1 of these cases autopsy showed cerebral hemorrhage; in the other, widespread infection of the brain. Twelve patients died after the completion of treatment, with an average survival time of twenty-five months. In 9 cases, recurrence in the cerebellum was either proved by exploration or autopsy or presumed on the basis of symptomatology.

Eleven diagrams and photographs.

JAMES H. GROVE, M.D.
Mt. Sinai Hospital of Cleveland

Radiotherapy in Cancer of the Breast, with Particular Reference to the Value of Preoperative Irradiation as a Supplement to Radical Mastectomy. Analysis of 1418 New Cases. Sigvard Kaae. Acta radiol., Supplement 98, 1952.

The author reports the results of therapy in 1,418 cases of carcinoma of the breast treated from 1931 to 1944 at the Radium Center, Copenhagen, with particular attention to the evaluation of preoperative roentgen therapy as a supplement to radical mastectomy.

The present method of choice in operable cases of breast cancer is *en bloc* removal of the breast, pectoral muscles, and axillary contents. Supra-radical operations, which include the mediastinal and supraclavicular chains, have not improved the results.

In this series, preoperative x-ray therapy was given in all cases technically operable. The dosage level employed from 1931 to May 31, 1938, is termed moderate, consisting of 1,600 r (tumor dose) in nine days to the breast and 800 r in nine days to the axilla. From June 1, 1938, to 1944, heavy preoperative irradiation was given, with a tumor dose of 3,500 r in one month to the breast and 3,300 r to the axilla.

A group of 463 technically operable carcinomas of the breast received complete preoperative roentgen therapy, and in some instances postoperative therapy.

For this group the five-year survival was 58 per cent. For histologic Stage I cases it was 74 per cent, and for histologic Stage II cases 40 per cent. There was no significant variation in the five-year results with moderate and heavy radiation in histologic Stage I cases. In Stage II, the difference between cases receiving moderate dosage (28 per cent alive and symptom-free) and those receiving heavy irradiation (38 per cent alive and symptom-free) is not statistically significant.

A slight increase in local recurrence was noted in cases with heavy preoperative therapy. Distant metastases decreased from 36 to 24 per cent with elevation of the total tumor dose.

The microscopic study of 268 cases proved by trephine biopsy revealed no carcinoma in 34 cases and in 5 cases the cancer cells showed marked radiation effects and were hardly capable of proliferation. Axillary nodes were not studied in a similar manner. The finding supports the opinion that x-ray therapy alone will not sterilize the primary lesion and is, therefore, not the treatment of choice in technically operable cases.

Seventy-four self-explanatory tables and 12 figures permit easy evaluation of the clinical features incident to this method of therapy.

Undoubtedly preoperative radiation therapy will improve the results of some cases of breast cancer with marked local progression of disease. Since the five-year survival is improved in only a small percentage, the use of heavy preoperative radiation in all technically operable cases is open to question. Investigations undertaken by Haagensen and Stout indicate that radical mastectomy is contraindicated in certain cases where a combination of signs and physical findings indicate that permanent cure is rarely obtained. In such cases, as well as in inoperable patients, the treatment is primarily radiological. Women before and about the menopause may often obtain marked temporary palliation from x-ray castration.

DAVID C. GASTINEAU, M.D.
Indiana University

Treatment by Irradiation of Lymphangiosarcoma in Postmastectomy Lymphedema. Report of a Case. Arnold J. Rawson and Joe Lee Frank, Jr. Cancer **6**: 269–272, March 1953.

In 1948, Stewart and Treves reported a distinctive syndrome consisting of a highly malignant lymphangiosarcoma of the edematous arm in certain women who have undergone radical mastectomies for cancer of the breast (Cancer **1**: 64, 1948). All of the reported cases have occurred in patients with lymphedema, and the malignant vascular tumors have appeared several years after operation. The authors report a case of lymphangiosarcoma occurring in a 70-year-old woman who had had a radical mastectomy fourteen years previously. A tumor dose of 4,980 r was given, using x-rays with a h.v.l. of 1.75 mm. Cu over a period of six weeks. The lesion responded well and at the time of the report the patient had been free of tumor for more than a year.

Two photographs; 2 photomicrographs; 1 table.

D. S. CHILDS, JR., M.D.
Mayo Clinic

Mediastinal Tumors of Thymic Origin. Frederick M. Binkley, Jack D. Thorburn, H. Brodie Stephens, and Orville F. Grimes. California Med. **78**: 267–273, April 1953.

Twenty-one mediastinal tumors of thymic origin studied at the University of California School of Medicine have been analyzed and arranged according to the classification of Lowenhaupt (Cancer **1**: 547, 1948) after histologic study of the excised specimen or biopsy. Sixteen were considered malignant and 5 benign. Eight of the patients were between twenty and thirty years of age, and each of these had a malignant tumor. Only 4 were in or past the sixth decade; 2 of these had malignant and 2 benign tumors.

Two of the 21 patients were considered to have myasthenia gravis, and in these the tumors were found to be benign, of the encapsulated type. Both were greatly improved symptomatically by surgical excision.

Surgery was attempted in 14 of the 21 cases. Four of the excised tumors, each considered to be malignant, were incompletely removed. The 10 tumors completely excised were divided equally between benign and malignant. There were 3 postoperative deaths.

Of 10 patients surviving and asymptomatic at the time of the report, 5 had benign tumors and 5 malignant. Of the 5 malignant tumors, 1 was treated by surgical excision alone; 2 were excised, but metastatic lesions appearing subsequently were irradiated. Two cases were considered inoperable and treated by radiation alone. The latter 2 were the only ones to receive a full tumor dose of 5,000–6,000 r within a period of approximately forty days. Both patients were apparently well after two years. Roentgen therapy was given to 10 of the other patients with malignant tumors as a palliative procedure. Two of these were alive and free of evident disease two years after irradiation, which consisted in each case of a little over 3,000 r tumor dose, following initial operative removal.

No correlation could be demonstrated in this limited series between survival rates and the pathological patterns of the tumors.

Eight roentgenograms; 6 photomicrographs; 5 tables.

ARTHUR S. TUCKER, M.D.
Cleveland Clinic

Pancoast Syndrome Due to Bronchiogenic Carcinoma: Successful Surgical Removal and Postoperative Irradiation. A Case Report. William M. Chardack and James D. MacCallum. J. Thoracic Surg. **25**: 402–412, April 1953.

The authors report a case of Pancoast syndrome treated by surgery and postoperative irradiation. A fifty-four-year-old white man complained of pain in the shoulder and in the medial aspect of the arm, forearm, and hand of two months duration. A roentgenogram of the right shoulder showed calcium deposits and a diagnosis of bursitis was made. The pain became more severe and paralysis of the ulnar nerve developed. Examination also showed a ptosis and myosis of the right eye. A chest film revealed a small density in the right apex. No definite bony erosion could be demonstrated. The diagnosis of apical bronchogenic carcinoma was considered, and the patient was operated upon. The tumor was found to extend through the apex of the pleural dome into the brachial plexus, involving roots C-7, C-8, and T-1. The involved roots were divided and the right upper lobe, with the tumor, was removed. Beginning three weeks after surgery 6,528 r (h.v.l. 2.5 mm. Cu) were delivered over fifty-four days to the general tumor area. Two and one-half years following the operation the patient was in excellent health, though there was no change in the extent of paralysis which was present immediately after the operation due to removal of the nerve roots.

In no previous case of Pancoast syndrome has the tumor been found to be resectable. In most cases the syndrome is of malignant origin, and the course is rapidly fatal. The duration of life from the time of appearance of symptoms has ranged from two to twenty-four months, the average being ten months. The control of pain in patients with this syndrome has been a major consideration. The removal of the lesion in this case provided good relief. The authors emphasize that the two-and-a-half-year survival does not necessarily indicate a cure.

It is the location of the lesion leading to compression and invasion of structures within and adjacent to the thoracic inlet which determines the clinical and diagnostic features of the Pancoast syndrome rather than any specific histologic type of tumor. Primary carcinoma of the lung originating in the apex accounts for the majority of the cases. Occasionally a benign lesion, such as tuberculoma, located in the apex of the lung may produce a Pancoast syndrome.

The authors conclude that any unexplained persistent neuritic pain in the upper lobe should be thoroughly investigated, with the possibility of a Pancoast syndrome in mind. Early surgical exploration is justified in that the causative lesion in a small number of cases has been shown to be benign. Even if malignant, it may be resectable, with considerable palliation.

Two roentgenograms; 3 photomicrographs; 1 photograph; 1 drawing. RENE G. FORTIER, M.D.
St. Paul, Minn.

Serous Cystadenocarcinoma of the Ovary. A Review of 127 Cases. Carl T. Javert and Robert R. Rascoe. S. Clin. North America **33:** 557–584, April 1953.

Serous cystadenocarcinoma is the most common type of ovarian cancer. The authors have reviewed a total of 127 cases seen over a period of twenty years, of which 110 (87 per cent) were followed. Sixty-eight patients, or 62 per cent, died within five years; 21 lived five years or more, and 21 were alive after shorter periods.

The study revealed four distinct factors which govern the prognosis of serous cancer, as follows: (*a*) operability, (*b*) stage of the disease, (*c*) degree of anaplasia, (*d*) irradiation therapy. From the point of view of operability there were three groups, depending upon whether or not the primary tumor was completely removed and the presence of metastases. Thirty-three cases (26 per cent) were operable and 94 (74 per cent) were inoperable. It is inoperability which is the chief cause of a poor prognosis.

The several varieties of serous cancer display different biological behavior. One often hears mentioned the case with extensive peritoneal metastases which melted away after x-ray therapy. The authors believe that these cases may actually be examples of so-called "endosalpingioma." Their series included 11 such tumors. These are the low-grade or "semimalignant" tumors of other writers. They are classified pathologically by the authors as Class I, according to nuclear size compared to a red cell.

Complete criteria for staging and classification of serous cystadenocarcinomas are presented. The stages, based on gross and microscopic extent of involvement, were as follows: Stage 0, anaplastic changes limited to epithelium; Stage I, invasion of capsule; Stage 2, pelvic metastases only; Stage 3, abdominal metastases; Stage 4, carcinomatosis. Unilateral tumors had a higher incidence of metastases and therefore a poorer prognosis than bilateral tumors. Because of this, the fact of unilateral or bilateral involvement was not considered in determining the stage of the disease.

Irradiation gave the best results in the operable group of 33 patients, with a gross survival rate of 78.5 per cent. It appeared to prolong life for a short time in the advanced cases, but did very little for the patients regarded as hopeless.

The five-year survival rates were as follows: Stage 0, 100 per cent; Stage 1, 45 per cent; Stage 2, 33 per cent; Stage 3, 15 per cent; Stage 4, 0 per cent. According to the degree of anaplasia, the five-year survival rates were: Class 1, 73 per cent; Class 2, 25 per cent; Class 3, 11 per cent; Class 4, 3 per cent.

Routine pelvic examination led to the diagnosis of only 4 asymptomatic cases. It was estimated that approximately 10,000 women must be examined routinely to diagnose one case of serous cancer.

Methods of operation and operative mortality are discussed.

Fifteen photographs and photomicrographs; 2 graphs; 1 nomogram; 17 tables.

L. R. JAMES, M.D.
Boston, Mass.

Treatment of Carcinoma of the Bladder. H. P. Winsbury-White. Lancet **1:** 757–760, April 18, 1953.

The treatment of carcinoma of the bladder begins with the regular supervision of simple papillomata for the earliest possible detection of malignant change. The cystoscopic appearances of carcinoma are quite characteristic and should present no difficulty to the expert eye.

Inclusion of non-invasive papillomata in statistical studies for the purpose of assessing the relative merits of irradiation and surgery confuses the issue, and has rendered most of the published results unsatisfactory. These simple non-invasive growths are successfully treated by cystoscopic diathermy. The author limits his observations to infiltrating growths, all of which were treated by radium or radon. His series includes 57 patients. Half of this number died within twelve months of treatment; 7 per cent survived more than four years, and of these some were expected to reach the five-year mark. One patient was alive after eleven and a half years.

The author uses a special type of bladder retractor and a long-handled introducer with pointed and cupped ends for insertion of radium needles. For radon seeds, also, he uses a special introducer, but his experience with this agent is limited. No details as to the radiation factors or dosage are given.

It is concluded that the results of radium therapy are better than those of cystectomy, but evidence is lacking that radon seeds have anything more than a palliative effect on invasive growths.

Four illustrations.

Ewing's Sarcoma. A Study of Fifty Cases Treated at the Massachusetts General Hospital, 1930–1952 Inclusive. C. C. Wang and Milford D. Schulz. New England J. Med. **248:** 571–576, April 2, 1953.

An analysis of a group of patients treated for histologically proved Ewing's sarcoma at the Massachusetts General Hospital from 1930 to 1952 is presented. Of a total of 50 cases, 36 were treated by external irradiation

alone, 10 by radical surgery, and 4 by surgery followed by x-ray therapy. Twenty-two of the 36 given radiation alone showed no distant metastases at the time of admission. In 14, metastases were present and treatment was for palliation. There were no evident metastases in the 14 treated surgically.

Of the surgically treated patients only 1 lived more than five years. Three of the 4 patients in whom operation was followed by irradiation died within six months; 1 was lost to follow-up after three months but was known to have pulmonary metastases.

Of the 22 patients who received external radiation for possible cure, 4 had survived, at the time of the report, from six to thirteen years. Another was alive with disease after four years and 2 without disease after two years and six months, respectively. Of those given irradiation for palliation only, 1 lived for seven years after the initial treatment, dying of widespread metastases. Twelve died within one year, and 1 died forty-two months after the first treatment.

Twenty-seven patients receiving irradiation to the primary lesion were completely relieved of pain shortly after treatment was begun. In most cases in which treatment was given for palliation the patient enjoyed considerable subjective relief.

Serial roentgenograms were available in 16 of the 22 patients treated for cure. Fourteen showed definite radiographic improvement, consisting of resolution of the soft-tissue mass and reossification of the destroyed bone.

Ewing's sarcoma is highly radiosensitive. The exact dose required to destroy the tumor has not been established. In the group under discussion, 1 patient whose primary and secondary lesions were temporarily controlled with only 1,000 r survived for seven years of comfortable life. In 2 cases it was shown that 3,000 r can destroy a tumor. In an occasional instance a dose as high as 5,000 r may not completely eradicate the disease. It is felt, however, that 4,000 to 5,000 r fractionated at the rate of 200 to 300 r (air incident) per day is probably sufficient for primary control of the majority of these tumors.

Radiation treatment of the primary tumor and of distant metastases offers palliation with the relief of discomfort and pain. Furthermore, the literature contains reports of "hopeless" cases with solitary metastatic lesions in the lungs in which long-term survival was obtained after vigorous radiation therapy. Perhaps larger dosage should be employed in these "hopeless" cases, with the aim of cure rather than palliation.

Six tables.

FRANK T. MORAN, M.D.
Auburn, N. Y.

Experience with Two Million Volt X-Ray Therapy and a Preliminary Assessment of Clinical Results. G. W. Blomfield. Proc. Roy. Soc. Med. **46**: 219–224, April 1953.

The author reports on the advantages of supervoltage irradiation over conventional deep x-ray therapy in a series of 749 patients treated over a two-year period, December 1949 to December 1951. Among the cases treated were intracranial tumors, carcinomas of the mouth, larynx, esophagus, bronchus and lungs, rectum, bladder, and cervix, as well as a non-malignant series, including induction of an artificial menopause. Treatment was given with a Van de Graaff generator at the 2 mev level, which is intermediate between conventional deep therapy and ultra-high voltage. Treatment at this energy level (2 mev) is similar to that from a high-output cobalt unit.

By comparison with conventional deep therapy, there was a decided gain with the use of 2 mev, as evidence by the diminished skin and mucosal reaction, combined with the accurate delivery of radiation to the proper site. The relative increase in depth dose is adequately demonstrated by isodose curves accompanying the article.

In cancer of the larynx and pharynx, the author is now using the cobalt beam for early cases and reserving supervoltage therapy for the more extensive cases. Deep-seated tumors, as those of the bladder and cervix, have shown a significant favorable effect as regards palliation and survival. Supplemental supervoltage radiation was given in carcinoma of the cervix to raise the dose at point B to a minimum of 3,500 r in early cases, and to 5,000 r in more advanced lesions.

The author admits that the follow-up in this series is short statistically, but long enough to show a distinct trend toward a decided advantage of treatment at 2 mev over that at the 200-kv. level.

Seven figures; 2 tables.

ROBERT H. LEAMING, M.D.
Memorial Center, N. Y.

High Energy Electrons for the Treatment of Extensive Superficial Malignant Lesions. John G. Trump, Kenneth A. Wright, W. W. Evans, John H. Anson, Hugh F. Hare, J. L. Fromer, Guy Jacque, and Kenneth W. Horne. Am. J. Roentgenol. **69**: 623–629, April 1953.

Controlled doses of normally incident and essentially monoenergetic electrons possess unique properties for the treatment of superficial malignant lesions. Such high-energy cathode rays produce their maximum effect under the skin level and can be confined to the tumor depth by proper choice of the accelerating voltage. The authors summarize some of the physical and biologic observations made with electrons of several million volts energy and report on the use of such high-energy cathode rays in the treatment of 4 patients, 2 of whom had mycosis fungoides and 2 an atopic dermatitis.

The similar biologic effect of high-energy cathode rays and roentgen rays is shown by observations on microorganisms treated in both ways. Even in complex structures the biologic effect should be similar, inasmuch as the result is due to ionization produced in tissues, which is essentially the same in either case. A graph shows the distribution of ionization by 2.5-million-volt electrons at 1 mm. intervals below the skin. The maximum dose is at the 3 mm. depth level and the skin dose is approximately 75 per cent of this maximum value.

The cathode-ray source was a compressed gas-insulated electrostatic accelerator of the Van de Graaff type. The 4 patients treated had extensive lesions which were no longer amenable to ordinary measures, including roentgen irradiation. Four portals were employed in order to treat the entire skin surface—one anterior, one posterior, and two lateral—with supplementary treatment when necessary to the crotch and underarm regions. The cathode ray beam passed through an aluminum cone with a defining slit, 5 mm. × 45 cm. The patient was placed on a motorized table, which moved at a rate of 6 feet per minute, and in this manner the entire anterior surface of the body was treated with the patient in a supine position. The

eyes were protected by conventional eye cups if the eyelids were involved or, if not, by covering the eye and lid by low atomic number material, 1.5 gm. per square centimeter. Covering of the scalp is also necessary unless epilation is desired. The epilating dose is not yet known, but it is less than 800 rep delivered in a period of ten days. Dosage has been approximately 1,400 rep in ten weeks, though some areas have received 2,200 rep. Careful blood studies have been made and no demonstrable change has been noted in the hematopoietic system. The 2 cases of mycosis fungoides have improved. In the 2 cases of atopic dermatitis only slight improvement has been obtained.

Six illustrations. RICHARD A. ELMER, M.D.
Atlanta, Ga.

Treatment of Oral Cavity Cancers. Present Status of Radiotherapy. Gilbert H. Fletcher. Texas State J. Med. **49**: 209–213, April 1953.

The author reviews the results of radiotherapy in cancers of the oral cavity, presenting results reported by various workers. He summarizes his paper as follows:

Both surgery and irradiation have their place in the treatment of oral cavity cancer, either as separate procedures or in combination. Irradiation can be given first to primary lesions of the lower alveolar ridges, floor of the mouth, and tongue. If failure is encountered, then the so-called combined operation (radical excision and removal of the primary lesion in one stage) still can be performed with no additional risk. Conversely, irradiation can be used primarily in the form of interstitial radium implantation to treat recurrences following surgery.

Low intensity radium implantation is by far the treatment of choice in oral cavity cancers with the exception of lips and tonsils, where external irradiation can play a considerable role. Small or moderately advanced lesions can be treated adequately with a tumor dose of 7,000 to 8,000 gamma r in about seven days. In large lesions, a dose of 3,000 gamma r to 4,000 gamma r in three or four days, followed by 3,000 r tumor dose from external irradiation starting immediately and delivered over a period of two to three weeks sometimes will give better results. This method insures a more homogeneous dose to the large volume of tissue which must be treated. Considerable clinical experience is necessary to determine the indication of the methods of treatment, their complications, and causes of failure. Great care must be given to the patient's general condition and oral hygiene.

Six roentgenograms; 3 tables.

A Simplified Automatic Isodose Recorder. A. Cole, E. B. Moore, and R. J. Shalek. Nucleonics **11**: 46–48, April 1953.

An apparatus is described which automatically determines and records the isodose contours around a localized source of radiation. It is applied to the particular case of complex configurations of radium and radiocobalt sources. The isodose contours are traced in any selected plane, and as many planes as are desired may be selected.

The detector is a small anthracene crystal connected by an aluminum light pipe to a photomultiplier tube, the output of which is referred against a preselected signal and the difference amplified in a Brown amplifier. The direction and amount of rotation of the motor which positions the recorder pen are determined by the polarity and magnitude of the signal impressed on the Brown amplifier. The pen, connected mechanically to the detector, moves radially with respect to a turntable bearing the chart. The source is mounted on the shaft of this turntable. With a semispherical crystal, 1.5 mm. in radius, the error due to departure from point size is only 3 per cent as close as 1 cm. from a 1.5 cm. linear source. The point-approximation error becomes increasingly larger at shorter distances.

The basis for expecting the integrated light output of the crystal to be proportional to the dose expressed in roentgens is outlined. Details of the mechanical construction of the detector and of the electronic circuit are given.

The authors refer to other apparatus essentially similar (see Hine and Friedman: Am. J. Roentgenol. **64**: 989, 1950. Abst. in Radiology **57**: 788, 1951). Such apparatus has real utility in a Department of Radiation Therapy where a large number of different configurations of localized radiation sources are employed, since it permits the determination of the resulting isodose surfaces without the great expenditure of the physicist's time required for a manual point-by-point determination.

Four illustrations. JOHN S. LAUGHLIN, PH.D.
Memorial Center, New York

RADIOISOTOPES

Discussion on the Use of Radioisotopes in Surgery. E. E. Pochin, F. T. Farmer, D. M. Wallace, Selwyn Taylor, and R. J. Walton. Proc. Roy. Soc. Med. **46**: 233–244, April 1953.

Pochin introduced this discussion by reviewing some of the important applications of radioisotope technics. By appropriate counting methods it can be determined not only where an isotope is concentrated, but when such material, injected intravenously, arrives at any particular position in the body. Also, since the counting rate is proportional to the amount of isotope present at a given distance from the counter, it is possible to estimate quantitatively the efficiency of an organ or a tissue in concentrating a particular element, as iodine in the thyroid, iron in the blood, mercurial diuretics in the urine, phosphate in the head of the fractured femur.

With thyroid cancer, the most direct method of detecting I^{131} uptake is to measure the radioactivity of tumor tissue removed at biopsy a few days after the test dose of I^{131} or by comparing its activity with that of a plasma sample taken at the same time. In practice, however, the detection of uptake commonly relies on external counting. However, I^{131} uptake may become detectable in tumor tissue only after the ablation of the thyroid, either by thyroidectomy or destruction by I^{131}. The former method is preferred so as to avoid unnecessary radiation dosage. It has been found that anaplastic thyroid carcinoma rarely develops powers of iodine concentration even after thyroid ablation, whereas the more differentiated tumors do so rather frequently.

All thyroid carcinomas which cannot be removed by radical operation should, if possible, be biopsied. If the radioiodine concentration can be demonstrated in the biopsy specimen, successive therapeutic doses of radio-

iodine are given at intervals of two to four months until no further abnormal sites of radioiodine concentration can be detected in the body. Myxedema following thyroid ablation can be controlled by thyroxine except during the weeks preceding each successive therapeutic dose.

With these principles in mind, with histologically differentiated thyroid carcinoma, there is commonly relief of symptoms or reduction of the tumor which can be maintained for several years at least. This form of treatment may even prove curative when the tumor has already spread remotely in bone, lungs, or via the lymphatics.

Farmer dealt with the application of radioisotopes as tracers in surgery, chiefly sodium 24. This latter isotope is particularly suitable for tracing movements of body fluids, since, when made up in the form of isotonic NaCl solution, it is completely miscible with the blood or extracellular fluid, while its short half-life (fifteen hours) means that it is active in the body for only a limited time so that the risk of radiation injury is small. At the same time, its penetrating gamma rays enable measurements to be made from without the body. Among a greater number of applications of this isotope, there are two of particular value; namely, the measurement of blood velocity by observing the time of transit of a small quantity of injected radiosodium from one point to another in a vein or artery, and the study of "clearance rates" of Na^{24} when injected into the tissues and allowed to be carried away by the dispersive processes of the body. This technic has been applied recently to the study of skin grafts in plastic surgery. The radiation dose given to the patient by these injections is quite small and presents no serious hazard.

Farmer also discussed the application of radioisotopes to brain surgery, particularly in regard to localization of tumors from without as well as within the cranium, either during biopsy or full operative procedure.

Wallace discussed the use of radioactive gold, tantalum, and cobalt in bladder cancer. Gold can be used as a substitute for radon seeds with a sheath of platinum to filter off the beta radiation. It is similar to radon in its short half-life (2.7 days) but differs in that the grains, if not used, can be reactivated at a nominal expense. Tantalum is an alternative for radium. When it is sheathed in platinum in the form of flexible wire there are no inactive ends, as with radium needles. Cobalt, in the form of a solid bead or needle, can be used for either intracavitary or interstitial irradiation. However, it is absorbed if left in contact with tissues and has to be plated to eliminate beta radiation. Cobalt, sodium, and bromine have been used in the form of radioactive solutions.

In the bladder, the ideal situation for interstitial therapy is a single tumor with minimal infiltration of the muscular wall. Intracavitary irradiation with radioactive solutions should be confined to multiple mucosal lesions that have not spread clinically into muscle. It should not be used in cases of low-grade papillary carcinomatosis that can be adequately controlled by repeated diathermy. The most important complication is the development of fresh tumors months or years after irradiation.

The use of radioactive iodine was again discussed by Taylor, who considered in turn tests of thyroid function, localization studies, the treatment of hyperthyroidism, and autoradiography. He regards radioiodine as much the kindest treatment from the patient's point of view. It is of most value for recurrent hyperthyroidism, especially when previous operation has paralyzed a vocal cord, for older patients with severe heart disease and those who cannot be prepared for surgery, and for patients with severe exophthalmos, in whom thyroidectomy may precipitate corneal ulceration.

Walton discussed the clinical uses of radioactive colloidal gold for malignant pleural and peritoneal effusions. He stated that half of the patients treated have received benefit by a slowing down or temporary complete cessation of fluid formation. Another use of radioactive colloidal gold has been in tumors of the face, breast, and parametrium, which have been directly infiltrated with the isotope. More recently the prostate has been included, with reports of rapid shrinkage of the tumor and its replacement by fibrous tissue.

Seven graphs.

ROBERT H. LEAMING, M.D.
Memorial Center, New York

Discussion on the Use of Isotopes in Neurology. W. V. Mayneord, R. D. Keynes, T. P. Morley *et al.* Proc. Roy. Soc. Med. **46**: 225–232, April 1953.

Mayneord introduced this discussion on the use of isotopes in neurology with a general consideration of the available isotopes and the chief methods of studying the radioactive content of tissues. The uptake of P^{32} by normal brain and by brain tumors has been measured in pathologic specimens, but its concentration, though easily detectable, is not such as to make it therapeutically useful. Nor can it be detected outside the intact skull, owing to the low penetration of the beta rays. For the purposes of external counting, a gamma emitter must be used, since the rays must traverse soft tissues and bone. A scintillation counter affords the best means of measurement. A number of such devices are described, including a scanning detector (Mayneord and Newbery) where each scintillation is recorded photographically, with the production of a "tele-autograph."

In concluding his remarks, Mayneord mentioned the use of di-iodofluorescein for localization of brain tumors, but his results with this method have not been encouraging.

Keynes reported experimental studies on nervous conduction through the use of Na^{24} and K^{42}. Since these isotopes emit large amounts of strong and easily detected radiation, they prove an ideal means for investigating ionic movement. Through their use, tracer evidence, both qualitative and quantitative, has been obtained which agrees with the present picture of the mechanism of nerve impulses.

Morley discussed the use of P^{32} in neurosurgical cases. The principle of its use in the detection of brain tumor is that there is a high concentration of phosphorus in a cellular tumor in comparison with the relatively sparse cell population of the surrounding brain. Following the intravenous administration of P^{32} the tumor may be localized by inserting a Geiger-Müller probe counter. This method is useful in securing needle biopsy specimens through a burr hole, in planning the brain incision where the tumor lies deep and is invisible, and in mapping the extent of a tumor and discovering its operability. The test is not specific for any particular type of tumor, and enhanced counts are also obtained in granulomas, the periphery of an abscess, and, to a lesser extent in recent infarcts.

Six illustrations.

ROBERT H. LEAMING, M.D.
Memorial Center, New York

Jet Injection of Radioisotopes. A Clinical Study Comparing Needle and Jet Injection of I^{131}, K^{42}, and Na^{24}. Franz K. Bauer, Benedict Cassen, Elsie Youtcheff, and Lucille Shoop. Am. J. M. Sc. **225**: 374–378, April 1953.

Jet injection (introduction by Hypospray[R] of small quantities of solution in the form of a high-speed jet of liquid through the skin) has been found to produce more uniform deposition of material than introduction by hypodermic needle. The authors investigated the disappearance rates of several radioisotopes, using both injection technics.

In each case, 0.5 microcurie of carrier-free I^{131} in 1 c.c. physiological saline was jet-injected into the anterior thigh. The injection sites were monitored by a closely placed wide-angle scintillation counter and values recorded as "half-times" (number of minutes required to reduce initial count by half). Seventeen healthy human controls (10 men and 7 women), with normal thyroid function as measured by I^{131} uptake, and 39 patients were studied. In some controls and patients, needle injections were also made in the opposite thigh and similarly measured. Normal half-times ranging from seven to seventeen minutes for men and seven to twenty-two minutes for women were determined. In 11 men and 3 women with hyperthyroidism the half-times were within the normal range. With hypothyroidism, prolonged half-times (eighteen to more than sixty minutes) were found in 6 men. Nine men with cardiac decompensation also showed prolonged half-times (seventeen to thirty-eight minutes), as did 10 men with previous decompensation who were now compensated (ten to thirty-two minutes). The half-times of hypothyroid patients approached normal as they responded to clinical therapy.

Comparison of the two injection methods showed a more uniform absorption, of exponential type, from jet injection. Absorption from needle injection was often prolonged, and the half-times were variable and non-exponential.

Similar studies using Na^{24} and K^{42} produced similar results.

One graph; 3 tables. JAMES M. SWAIN, M.D.
Cleveland Clinic

Size of Dose: Its Effect on Distribution in the Body. Herbert E. Stokinger. Nucleonics **11**: 24–27, April 1953.

The hazards of the assumption that the same distribution in the organs of a body occurs for an isotope administered in tracer amounts as in larger doses are emphasized in this article. The author describes his own research and that of others to illustrate the dependence of the distribution of various elements on dose.

Early data on the deposition of beryllium in dogs following inhalation of beryllium sulfate are reviewed. An increase in dose of approximately tenfold resulted in an increased deposit in the liver of about fiftyfold, while the concentration in the spleen remained constant. More recent work with the intravenous injection of beryllium in rats and rabbits with differences in doses of a millionfold produced large differences in the liver and spleen but essentially no change in the amount deposited in kidney and bone. This behavior of beryllium is accounted for by its formation in colloidal aggregates above minute concentrations at the *p*H of body fluids. Removal of these aggregates by phagocytic action then determines the beryllium distribution.

Similar effects are recounted for silver deposition. Over a dosage range of 10^8, liver and spleen in rats showed up to a three-hundredfold increase, while other body constituents (kidney, blood, etc.) increased only about sixfold. Since silver exists in the ionic state at physiologic *p*H's, its distribution is explained by the author on the basis of its complexing action with proteins.

Data for uranium and yttrium also indicate unexpected distribution patterns as a function of dose. Calcium, however, is cited as an example of an element for which large dose differences do not affect the metabolism. The uptake of iodine in the thyroid and the distribution of iron are further examples of metabolic functions which are influenced by the dose.

The importance of impurities in radioisotopes is also properly emphasized as a source of error in the interpretation of metabolic experiments.

JOHN S. LAUGHLIN, PH.D.
Memorial Center, New York

A Photographic Method of Determining the Distribution of Radioactive Material in Vivo. Sven A. E. Johansson and Bengt Skanse. Acta radiol. **39**: 317–322, April 1953.

The authors describe an apparatus with which it is possible to obtain a photograph of the distribution of a radioactive material in a tissue. A perforated lead plate, the thickness of which is determined by the energy of the radiation to be studied, is placed between the photographic plate and the radioactive source. The size of the perforations is governed by the intensity of the radiation. A thickness of 20 mm. and square perforations measuring 3 mm. and separated by spaces of the same dimensions have been found suitable for a number of measurements. A thallium-activated sodium iodide crystal, in the form of a plate about 5 mm. thick, is placed between the lead plate and the film. This crystal absorbs the gamma rays and transforms part of the energy into light, which is then registered on the film. The concentration of the radioisotope would otherwise be too small for this method. The minimum concentration of the radioactive isotope required for blackening of the plate is 10 microcuries per square centimeter.

The authors believe that such a method, yielding multiple small readings over an area, is more accurate and achieves much more easily the same result as multiple readings by a Geiger-Müller tube with a narrow collimator. Less radioactive material is required than for the pinhole camera method.

This method has been used successfully by the authors to determine the uptake of radioiodine by the thyroid and by metastases from thyroid carcinoma.

A diagram and several examples of photographic plates are shown. STANLEY ABO, M.D.
Mt. Sinai Hospital of Cleveland

The Use of Radioactive Iodine in the Diagnosis and Treatment of Hyperthyroidism. Robert E. Mack. Missouri Med. **50**: 267–271, April 1953.

Following a review of the metabolism of thyroid hormone, the author considers the tests of thyroid function using radioiodine. In general, there are three approaches, with individual variations. The first is the measurement of urinary excretion totally or fractionally

for a few days following a tracer dose. Since most of the administered dose not utilized by the thyroid is excreted in the urine, this serves as an indirect assay of thyroid uptake. Hyperthyroid individuals excrete less than a normal amount but there is some overlap between euthyroid and hyperthyroid states. Disadvantages are (1) falsely low urinary excretion in patients with cardiac failure because of the longer elimination period, and (2) false results due to loss of even a small portion of the sample by an unco-operative patient.

The second approach is that utilizing measurements over the thyroid to determine directly the amount contained by the gland. The chief variation is in the time of measurement and distance of the detector from the neck. Hyperthyroidism is indicated by an uptake of more than 50 per cent. In a few cases overlapping appears between euthyroidism and hyperthyroidism, chiefly at levels between 40 and 50 per cent, constituting one objection to the direct uptake method.

The third method is the measurement of radioactivity in various serum compartments and their comparison to one another or to some standard. This has been used for research studies.

Tracer studies are a measure of the functional capacity of the thyroid gland to take up iodine, and as such must be interpreted in the light of the clinical status of the patient. The possibility of previous drug therapy must be considered when an uptake value is not in keeping with the clinical estimate of the patient. Iodine medication prevents the uptake of radioactive iodine, and the length of time that must elapse before determinations reach a normal level depends upon the clinical status. In the euthyroid subject receiving iodine as long as ten weeks may elapse before accurate results are obtained, but in the hyperthyroid patient uptake may be observed as early as twelve to fourteen days following cessation of iodine therapy.

The surgical treatment of hyperthyroidism deserves serious consideration, especially with the development of adequate technics for preoperative and postoperative care. It has the advantage of exposing the pathology, and is important in nodular goiter in which malignant change might be present. The disadvantages are the hazards attendant upon any surgical procedure and the danger of damage to the vocal cords or parathyroid glands.

Radioiodine has the therapeutic advantage of being almost completely effective in controlling the disease. There is no discomfort in administration, it is relatively cheap, and produces few complications. The chief disadvantages consist of a delay of six to eight weeks before full therapeutic effect is realized, and a lack of definite knowledge of the future changes which may take place as a result of semichronic in radiation of the gland. Some question has arisen as to the possibility of late development of cancer, but as yet there has been no evidence of such an outcome. Studies on previously irradiated thyroid glands show chiefly fibrosis and atrophy, with some areas of hyperplasia.

Nodular goiters do not respond as well generally to radioiodine as diffusely enlarged goiters. Because of this and the higher incidence of cancer in nodular goiter, surgery is recommended. Radioiodine should be considered the treatment of choice in hyperthyroid patients over forty-five or with less than twenty-five years life expectancy, and in patients with postoperative recurrences. FRANK T. MORAN, M.D.
Auburn, N. Y.

Measurement of Thyroxin Synthesis with I^{131}. A Test for Evaluation of Thyroid Function in Equivocal States. M. E. Morton. California Med. **78**: 277–279, April 1953.

The thyroxin synthesis test was used to evaluate thyroid activity in 500 patients at the Veterans Administration Hospitals in Van Nuys and Long Beach, Calif. Serum taken twenty-four hours after oral administration of 100 μc of carrier-free radioiodine was analyzed for total radioactive iodine and for radioactive iodine in the thyroxin form. The results of the test are expressed as the percentage of total radioactivity contributed to this specimen by thyroxin. This is believed to give a clearer separation of hypo- and hyperthyroid individuals from normal persons than do protein-bound iodine determinations or measurement of uptake of radioiodine. A 2-c.c. sample of serum is necessary.

Normal values were found to range from 2 to 10 per cent. In most hyperthyroid persons the value was between 50 and 70 per cent. In nearly 95 per cent of hypothyroid patients it was less than 1 per cent.

The test has also been used to detect metastases from thyroid carcinomas following total thyroidectomy which are so small as to elude scanning technics.

Five graphs; 1 table. ARTHUR S. TUCKER, M.D.
Cleveland Clinic

The Rate of Formation of Nondiffusible (Organic) Fraction of I^{131} in Plasma Correlated with Apparent Thyroid State. William E. White. J. Lab. & Clin. Med. **41**: 516–520, April 1953.

A method is described which uses the determination of the red cell : plasma I^{131} ratio for calculating the rate of formation of non-diffusible (organic) fraction of I^{131} in plasma in varied thyroid states following the oral administration of inorganic I^{131}.

In a study of 40 patients with clinical evidence of hyperthyroidism or hypothyroidism and a group of 70 euthyroid subjects, the percentage of non-diffusible plasma I^{131} thus calculated appeared to differentiate between hyperthyroid and euthyroid states most dependably at twenty-four hours, whereas optimum differentiation between hypothyroid and euthyroid states was not observed until seventy-two hours following the ingestion of inorganic I^{131}.

Radioactive Iodine-Labeled Fat. M. C. Hoffman. J. Lab. & Clin. Med. **41**: 521–525, April 1953.

A method of labeling fat with radioactive iodine has been devised for the purpose of studying changes in the absorption and distribution of fat in the body. I^{131} is particularly useful for this purpose because it forms a chemically stable compound with unsaturated fatty acids, has a convenient half-life, and may be measured easily.

In experiments on rabbits, a distinct contrast was found between the distribution of inorganic iodide and iodine bound to fat. The results compare favorably with the data presented by others on the distribution of fat labeled with other agents.

Metabolism and Distribution of Colloidal Au^{198} Injected into Serous Cavities for Treatment of Effusions Associated with Malignant Neoplasms. Gould A. Andrews, Samuel W. Root, and Ralph M. Kniseley. Cancer **6**: 294–302, March 1953.

The authors report studies on 39 patients with pleural

or peritoneal effusion treated with radioactive gold (Au^{198}). In the attempt to determine the fate of the isotope in the cavity, extensive records were made of the radioactivity levels of the fluid for several days after the injection. The fall in concentration of the radioactivity, after correction for decay, suggested that either the gold was being diluted by further fluid production or being removed from the fluid, or both. Tissue assay indicated that a large portion of the radioactive gold became fixed in a superficial position on the serous surfaces. Radioautograms of removed tissue showed that the activity of the isotope is limited to the first several millimeters.

Measurements were made of radioactivity in the blood, and the red cell and plasma fractions were assayed for radioactivity. The plasma showed levels of activity considerably greater than those of the red cells. The total radioactivity in the blood, however, was low in relation to the total dose of the isotope. The authors calculated that the amount present in the blood at any one time was less than 1 per cent of what was given.

Urinary excretion studies revealed that a small portion of the total dose of the isotope is excreted in the urine, with the highest output taking place in twenty-four hours.

Assays of tissue removed either at surgery or postmortem from 15 patients are presented. In most cases samples from the wall of the treated cavity had an activity considerably higher than that of the fluid within the cavity. In 9 patients an attempt was made to estimate, from the radioactivity of a specimen from the liver, how much of the total dose was deposited in that organ. Values obtained ranged from no activity to 15 per cent of the total dose.

The authors discuss some of the possible mechanisms for the action of this isotope on fluid formation.

Numerous graphs and tables are presented. Reference should be made to the original paper for the data presented.

Ten figures; 8 tables. D. S. CHILDS, JR., M.D.
Mayo Clinic

Pathological Changes Following Intracavitary Therapy with Colloidal Au^{198}. Ralph M. Kniseley and Gould A. Andrews. Cancer **6**: 303–312, March 1953.

The authors here report the autopsy findings in 12 patients who had been treated by intracavitary injection of colloidal Au^{198} (see also preceding abstract). The doses of radiogold varied widely. The largest single dose was 180 mc. and the largest amount given to any one patient was 659 mc. over a ten-month period. In some cases, in which death appeared imminent, and after previously administered radiogold had largely decayed, a small tracer dose of gold was given in order to measure the distribution of the isotope postmortem.

The authors point out that their observations were made on a small and varied group of patients with a wide range in the type of tumor, dosage of the isotope, and the interval between treatment and death. No obvious pattern of response to the isotope was found, and interpretation of the findings was difficult because of the many factors besides those of treatment.

The walls of the treated cavity seemed to have a fairly typical gross appearance. The gold stains the surface of the tissue a dark blue color. Gross changes also included a thickening of the pleural and peritoneal surfaces. Partial obliteration of the space was occasionally seen. Studies of the regions where the largest amount of the colloidal gold was deposited showed that the original colloid particles had coalesced to form granules. Numerous clumps of these were seen at various levels near the serosal surface. Most often these granules were in phagocytes which were enmeshed in fibrin.

In general, no demonstrable gross effect was noted from the irradiation by the isotope. In one case, however, radiation ulcers were found in the intestines. No characteristic changes that could be ascribed to therapy were observed in either the liver or the spleen.

Nine photomicrographs; 1 table.

D. S. CHILDS, JR., M.D.
Mayo Clinic

Use of Colloidal Au^{198} for Obtaining Scintigrams of the Liver. Eric T. Yuhl, Lloyd A. Stirrett, and Benedict Cassen. Nucleonics **11**: 54–56, April 1953.

This report describes an investigation to determine if the affinity of the reticulo-endothelial cells of the liver for colloidal radioactive gold is sufficiently specific to permit obtaining "scintigram" outlines of the liver with a scanning scintillation counter apparatus. Single intravenous injections of sterile colloidal radioactive gold were made in anesthetized cats and rabbits. Scanning was started immediately after injections and repeated at various intervals over a period of ninety-six hours. Hepatic scintigrams of 4 cats and 2 rabbits were obtained. Marked concentration in the liver is displayed in reproductions of some of the actual scintigrams. Doses up to 500 microcuries were employed, the higher doses producing better delineation of the liver. Radiogold appeared in the liver area within a few minutes after injection and reached its maximum concentration within one hour.

Examination of the liver *in vitro* confirmed close anatomic correlation with the scintogram, and showed that the tissue was normal. The doses required at present are too high for human application.

Three scintigrams. JOHN S. LAUGHLIN, PH.D.
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Distribution and Excretion of Radioactive Isoniazid in Tuberculous Patients. W. R. Barclay, R. H. Ebert, G. V. LeRoy, R. W. Manthei, and L. J. Roth. J.A.M.A. **151**: 1384–1388, April 18, 1953.

The isotope tracer technic provides an extremely sensitive and relatively simple method of determining small amounts of a drug and its metabolites in tissues and in body fluids. C^{14}-labeled isoniazid has been used to study the distribution and excretion of this bacteriostatic agent in tuberculous patients. Observations were made on 3 patients with tuberculosis (1 with active pulmonary disease, 1 with tuberculous adenitis, and the third with tuberculous pleural effusion) who received tracer doses of C^{14}-labeled radioactive isoniazid. Peak levels were reached in the blood and plasma within an hour after intramuscular injection. The levels fell rapidly for eight hours but measurable quantities of the drug persisted for three to seven days after a single injection.

Isoniazid is freely diffusible in unaffected tissues, including the spinal fluid. The highest concentration is in the lung and skin, the lowest in fat and bone. Diffusion occurs freely into dense caseous lesions in both the lungs and lymph nodes, and into the pleural fluid. Excretion is chiefly by the kidneys but small amounts

are excreted in the feces, and as carbon dioxide by the lungs.

Now that it is known that isoniazid penetrates necrotic tissues in sufficient concentration to influence the tubercle bacillus, it remains to be seen how long an effective concentration persists.

Two graphs; 5 tables. PAUL MASSIK, M.D.
Quincy, Mass.

The Exchange of Sodium Between Plasma and Extracellular Compartments in Pregnant Women as Determined by Na^{24} Tracer Methods. L. Woodrow Cox and T. A. Chalmers. J. Obst. & Gynaec. Brit. Emp. **60**: 195–202, April 1953.

The Transfer of Sodium Across the Human Placenta Determined by Na^{24} Tracer Methods. L. Woodrow Cox and T. A. Chalmers. Ibid, pp. 203–213.

The Effect of Pre-Eclamptic Toxaemia on the Exchange of Sodium in the Body and the Transfer of Sodium Across the Placenta Measured by Na^{24} Tracer Methods. L. Woodrow Cox and T. A. Chalmers. Ibid, pp. 214–221.

The Transfer of Sodium to the Amniotic Fluid in Normal and Abnormal Cases, Determined by Na^{24} Tracer Methods. L. Woodrow Cox and T. A. Chalmers. Ibid, pp. 222–225.

The Transfer of Sodium to the Placental Blood During the Third Stage of Labour Determined by Na^{24} Tracer Methods. L. Woodrow Cox and T. A. Chalmers. Ibid, pp. 226–229.

In the series of studies covered by the above titles, radioactive sodium (Na^{24}) was used as a tracer to determine the fate of sodium injected into the pregnant woman. Isotonic sodium chloride labeled with Na^{24} was injected intravenously, following which the maternal, fetal, and placental blood and the amniotic fluid were assayed for radioactivity.

Immediately following the moment of injection, all the Na^{24} is found to be contained in the maternal plasma. Diffusion out of the plasma follows at once and as soon as the circulating Na^{24} reaches the uterine sinuses, transfer across the placenta commences. The quantity of sodium transferred was shown to be on an average 450 times greater than is needed for fetal growth at the particular period of gestation. In certain patients with pre-eclamptic toxemia anomalous plasma concentration curves were obtained, and in these cases the rate of transfer of sodium across the placenta was diminished. This diminished trans-placental transfer was found in all patients with recurrent toxemia.

The percentage of sodium in the amniotic fluid exchanged every hour was 19.1 in normal patients and 2.8 in cases of hydramnios. The total quantity exchanged per hour was of the same order in normal cases in both groups. Na^{24} appears in the amniotic fluid within six minutes of its injection into the mother.

In 33 of 36 cases, samples of placental blood taken at the end of the third stage of labor, following injection of the labeled sodium just prior to delivery, showed a higher concentration of Na^{24} than samples of cord blood, which would suggest that an active uterine circulation persists in the first few minutes of the third stage. When the injection was made during the third stage (3 cases), an appreciable quantity of Na^{24} was transferred to the placental blood, confirming the inference that some circulation exists through the placental site.

The papers contain many details of the actual studies and a number of graphs and tables.

Biological Studies with Arsenic^{76}. IV. The Histopathologic Effect of Arsenic^{76} upon the Hematopoietic Tissues of Patients with Leukemia. Matthew Block, Leon O. Jacobson, and William Neal. J. Lab. & Clin. Med. **41**: 499–515, April 1953.

This paper is the fourth of a series on the medical applications of arsenic (As^{76}), a radioisotope with a half-life of 26.8 hours and emitting energetic beta and gamma rays (Proc. Soc. Exper. Biol. & Med. **69**: 270, 1948; Ibid **69**: 548, 1948; J. Lab. & Clin. Med. **34**: 1366, 1949. Abst. in Radiology **55**: 473, 1950). The purpose of the study described here was to investigate the histopathologic effects of As^{76} upon hematopoietic tissues including liver and spleen in order to determine its mode of action. A total of 61 marrow biopsies, 23 spleen biopsies, 11 liver biopsies, and 3 lymph node biopsies were obtained from 19 patients, 15 with leukemia, 1 with polycythemia vera, 2 with multiple myeloma, and 1 with metastatic carcinoma.

The importance of adequate control material became apparent early in the study. Repeatedly, foci of degenerating cells, complete absence of mitoses, or slight variations in cellularity or unusual ratios of cells to one another were encountered in the post-treatment tissues. These phenomena ordinarily would have been ascribed to the effects of treatment had they not also been found occasionally in pretreatment biopsies. Moreover, there was a tendency for the tissues of any one patient to accumulate iron and for the spleen to undergo a sarcomatous change with the passage of months and years, metamorphoses which could easily have been ascribed to each succeeding course of treatment had not a biopsy been obtained prior to each new course. In general, it must be emphasized that the changes observed microscopically that could be ascribed to treatment were minimal and in no way proportional to the sometimes dramatic improvement in the peripheral blood and clinical course of some of the patients. Noteworthy was the lack of change of architecture and the lack of decrease of immature cells following treatment in all cases. There was no evidence that irradiation decreased the number of immature cells and increased the number of mature cells, as has been claimed.

The authors conclude that at the level of irradiation dosage following injection of As^{76} evidence of cellular destruction may be occasionally demonstrable, in some cases followed by decreased cellularity.

In general, there is either no evidence or insufficient evidence of cytolysis or inhibition of cellular proliferation to account for the remissions produced. There is no evidence that immature rapidly dividing cells are more sensitive or that irradiation by As^{76} induces a right shift in benign or neoplastic hematopoietic tissues.

The concept is presented that irradiation in particular and cytotoxic therapy in general will probably not achieve a cure of the diseases under discussion.

Twenty photomicrographs; 1 table.

The Effect of Cobalt-60 Gamma Radiation on Passive Immunity. William M. Hale and Richard D. Stoner. Yale J. Biol. & Med. **25**: 326–333, April 1953.

A study was carried out by subjecting mice to controlled amounts of uniform whole-body irradiation by cobalt 60, following which experiments were undertaken to determine its effect on passive immunity to pneumococcus Type III; on passive immunity to tetanus antitoxin; and on active immunity to influenza Type A.

The animals which received 625 rep. three days before the injection of a mixture of pneumococcus Type III and specific antiserum were unable to withstand the infection. Ninety-four per cent of the animals in this group died, while no deaths occurred in a similar control group which received the mixture of the Type III organisms and the pneumococcus serum but were not irradiated. No deaths occurred in another control group receiving radiation alone. Neither white blood cells nor whole blood tranfusions were effective in restoring the resistance to the irradiated animals.

The effect of irradiation from cobalt 60 on passive immunity to tetanus toxin was investigated by injecting tetanus toxin-antitoxin mixtures into mice before intense whole-body irradiation (750 rep.) and into similar control groups which were not irradiated. A slightly greater degree of paralysis was found in the irradiated mice, although there was not enough difference to be considered definitely of significance.

In completing the series of experiments, two groups of mice were actively immunized against influenza Type A virus. One group received whole-body irradiation in the dosage range of 700 rep., following which intranasal infection was carried out. The other group was infected, but the irradiation was omitted. Control groups which had not been actively immunized were also used. The results obtained show that the active immunity to the Type A virus is not altered by this form of irradiation.

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RADIATION EFFECTS

A Cellular Index of Sensitivity to Ionizing Radiation. The Sensitization Response. Ruth M. Graham and John Barkley Graham. Cancer **6**: 215–223, March 1953.

Since 1945, the authors have been studying cell changes in the vaginal smear following irradiation. They have developed a method which they feel serves as a fairly accurate prognostic index for cancer of the cervix treated by irradiation. This method consisted in observing the irradiation effect in 100 consecutive non-malignant epithelial cells in the vaginal smear. If 75 per cent or more of these benign cells showed irradiation changes, the patient was regarded as sensitive to irradiation. If less than 60 per cent of the cells showed an irradiation effect, the patient was considered to be radiation-resistant. In a series of 125 cases of primary cancer of the cervix treated by irradiation and followed for five years, the difference in survival between the two groups appeared rather pronounced.

In reviewing this, and other material, the authors found that in certain cases a significant number of cells showed what was considered to be a "radiation effect." To their surprise, they discovered that many of these smears were control smears taken before radiation had been given. Further examination of these cases thought to have radiation changes before any radiation had been given showed that they were unusually sensitive to radiation after it had been administered. The change most frequently noted was a vacuolization in the basal cells. The authors had previously noted similar changes during experiments in which an attempt was made to enhance sensitivity of mice by the injection of various chemical agents. Because this histologic phenomenon appeared to correlate with radiosensitivity, the authors call it the "sensitization response."

The "sensitization response" is observed primarily in the basal cells, i.e., those from the transitional layer. Normal basal cells in the vaginal smear are shown by the Papanicolaou method to have large well staining basophilic nuclei and a rim of blue-green cytoplasm. The basal cell with "sensitization response" shows a characteristic change in the staining of the cytoplasm, which becomes deep lavender in color; red granules appear in the vacuolated cytoplasms.

Smears from 100 unselected patients with cancer of the cervix to be treated with roentgen rays and radium, during the period 1944 to 1947, were studied before irradiation. At least 100 non-malignant cells were counted in each smear and the "sensitization response" was considered significant if it appeared in 10 per cent or more of these cells. Thirty-five patients showed a significant response and, of these, 66 per cent are living and well at five years. Of the 65 patients showing no response, 82 per cent are dead.

The authors believe that this "sensitization response" may be of value in prognosis and treatment in patients with cancer of the cervix. They include illustrations explaining the histologic changes noted in the "sensitization response."

Fifteen photomicrographs; 5 tables.

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Discussion on the Radiation Syndrome. W. M. Court Brown, R. F. Mahler *et al.* Proc. Roy. Soc. Med. **46**: 245–252, April 1953.

Brown and Mahler discussed the general radiation syndrome following a single dose of x- or gamma-rays. These events are grouped into four periods: the initial reaction, which occurs about two hours after exposure, characterized by nausea, vomiting, and fatigue; the acute reaction, which develops toward the end of the second week and lasts for at least two additional weeks, characterized by ulceration of the gastrointestinal tract, acute marrow failure, bacterial infections and epilation; the subacute reaction toward the end of the sixth week, during which chronic forms of infection become manifest, and finally, the period of chronic reaction, which may last for several years, during which anemia and malnutrition occur, and possibly the development of leukemia. Studies were carried out on a series of 50 patients who had been referred for radiotherapy and demonstrated a pattern of symptoms simulating a mild version of the period of initial reaction. Dosage was expressed in megagram roentgens, an index of the total amount of energy absorbed by the body. The chief sites of irradiation were the whole length of the spine, the upper half of the trunk, and the abdomen. The mean dose to the first two sites was 3.9 megagram roentgens and to the abdomen 3.3 megagram roentgens. The pattern of events following such a dose includes a latent period of acute disturbance and a period of recovery.

It was found that, with a constant dose of roentgen irradiation, symptoms are more likely to develop at an earlier stage in the more sensitive patient than in the patient with a greater degree of resistance.

In this series there were no significant changes in the

red cell counts and hemoglobin limits. An initial leukocytosis was followed by a gradual leukopenia with maximum depression between the seventh and twelfth days. There was frequently a negative state of salt and water balance associated with radiation sickness. There were no consistent changes in the plasma limits of sodium, chloride, or phosphorus, while at the same time there was a rise in the excretion rates of these substances associated with the onset of symptoms.

Other speakers considered briefly various aspects of radiation sickness. Barnes and Loutit reported on the protective effects of implants of splenic tissue, though their results were not as striking as those reported by Jacobson *et al.*, who claimed that the MLD for CF_1 mice is raised from about 550 r to 1,025 r by this means (J. Lab. & Clin. Med. **37**: 683, 1951. Abst. in Radiology **58**: 796, 1952). The present workers attempted to increase the percentage of "takes" of implanted spleens by splenectomy prior to irradiation, but this did not appear to affect the subsequent outcome. Experiments in which a splenic tissue mush was injected intravenously gave superior results to those with intraperitoneal injection.

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The Production of ACTH in the Patient Undergoing Gynecologic Surgery or Receiving Pelvic Irradiation. Allan C. Barnes. Am. J. Obst. & Gynec. **65**: 758–772, April 1953.

A series of 12 patients, of whom 6 underwent pelvic surgery and 6 received radiation therapy for carcinoma of the cervix, were studied for evidence of resultant pituitary stimulation and ACTH production. Production of ACTH was determined by simultaneous balance studies of sodium, potassium, and nitrogen, with daily 17-ketosteroid determinations and eosinophil and lymphocyte counts. With all other metabolic influences controlled, the pattern of sodium retention with the spilling of potassium and nitrogen, together with a passing depression of the white cells studied and a brief increase followed by a drop in 17-ketosteroid level, was interpreted as the characteristic pattern indicating the elaboration of ACTH.

The observations in the surgical cases indicated that operation is a form of stress which results in the elaboration of ACTH by the pituitary.

The irradiated group of patients all had cervical carcinoma (Groups II to IV) and all had received external x-ray therapy, with a tumor dose between 2,000 and 2,500 r. They were then observed until metabolic balance reached equilibrium, after which intrapelvic therapy with Co^{60} was instituted. There was evidence of minimal pituitary stimulation due to application and removal of the cobalt by a method in which vaginal templates and interstitial needles were used (see Am. J. Roentgenol. **65**: 737, 1951. Abst. in Radiology **58**: 628, 1952), but the irradiation itself apparently did not represent as stressful a situation as the process of application. In 4 patients who were followed as long as 104 days, there was no evidence of delayed pituitary stimulation. Thorn tests were done on 6 patients with cervical carcinomas and there was pituitary-adrenal response, indicating that cancer does not interfere with pituitary stimulation.

Ten illustrations, including 3 roentgenograms.

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Effects of Fractionated Doses of X-radiation on Normal and Tumor Tissue. L. C. Fogg and R. F. Cowing. Cancer Research **13**: 321–326, April-May 1953.

The authors supplement their earlier reports (Cancer Research **11**: 23 and 81, 1951. Abst. in Radiology **58**: 323, 1952) with further data on the effects of fractionated doses of roentgen rays on mouse testes, on germinal cells in the ovary, and on mouse tumor. Their investigations confirm the belief that there is more than one kind of resting spermatogonia and that these differ in their resistance to roentgen irradiation.

A total of 210 mice were used in the experimental work, 84 C57 males for the testes study, 66 C57 females for the ovary experiment, and 27 C57 mice with transplanted S 180 tumors, together with 33 C3H females bearing spontaneous mammary adenocarcinomas, for the tumor studies. Five doses of 294 r each were given at intervals of four days, with the following factors: 100 kv.p., 15 ma., 2.6 mm. Al half-value layer, 77 r per minute, target-skin distance 32 cm. Shielding of the animals was accomplished by placing lead plates over the body, leaving exposed only that anatomical region involving the organs in which the authors were interested, specifically, the testes or ovaries. When the tumors were irradiated, a similar procedure was followed, with only the tumor region exposed while the rest of the animal was shielded.

Fractionated doses of 294 r were found to produce a greater effect on spermatogonia and spermatocytes in partially shielded mice than an equivalent acute dose. After irradiation has caused depopulation of the tubules of spermatogonia, subsequent recovery is from capsular cells, called prespermatogonia. These cells are more resistant to radiation than are spermatogonia.

Oocytes and spermatocytes were shown to be relatively comparable in their response to doses of irradiation. As compared to the testis, recovery following depopulation of germinal cells in the ovary is greatly delayed.

The fractionated dose required to depopulate the testis or ovary of germinal cells is not sufficient to cause destruction of all tumor cells in the tumors studied, namely, spontaneous mammary adenocarcinoma in C3H mice and the transplantable S 180 in the C57 mice.

Apparently, induced resistance has not been achieved by repeated doses of irradiation under the conditions of the present investigation.

Three charts; 1 table.

Cytological Changes Following Roentgen Irradiation of the Liver in Mice. M. E. Wilson and R. E. Stowell. J. Nat. Cancer Inst. **13**: 1123–1137, April 1953.

X-ray radiation in doses up to 12,000 r was delivered to the liver region of mice. Loss of weight occurred at a rate comparable to starvation effects. Therefore, to distinguish between the effects of fasting and irradiation, an experiment was conducted in which both the control and the irradiated mice were fasted. The following observations were made:

1. Irradiated mice livers weighed less in relation to body weight than controls.
2. In irradiated mice, cell size decreased, due principally to a decrease in lipid.
3. Fat in controls was equally distributed in the cells, while in the irradiated rats the fat was found principally in cells at the center of each liver lobule.

4. Peripheral cells (nearer the portal areas) were more sensitive to irradiation than central cells.

Nine photomicrographs; 1 table.

PAUL MASSIK, M.D.
Quincy, Mass.

Effect of 2,000 Roentgens Local X-Irradiation on Metabolism and Alkaline Phosphatase Activity of Rat Bone. S. H. Cohn and J. K. Gong. Am. J. Physiol. **173:** 115–119, April 1953.

The object of the present investigation was to study some of the quantitative effects of irradiation on bone growth and calcium metabolism, and to investigate the mechanism by which irradiation produces these effects. Particular attention was given to the relationship between alkaline phosphatase activity and bone matrix formation in normal and irradiated animals.

One tibia of each of a large group of young rats of uniform age was given 2,000 r irradiation. Dosage factors were 250 kv.p., 15 ma., aluminum and copper filtration, 35 cm. target-skin distance, 9.3 minute exposure. The animals were followed to adult life and the growth and calcification of both tibiae and the tibiae in a control group of rats were studied.

A dose of 2,000 r administered to one leg produced chiefly local effects in the skeletal tissue of the young growing rats. A non-local effect was a depression of the serum alkaline phosphatase, which would indicate that the bone is probably one of the sources of serum alkaline phosphatase. A comparison of the matrix weight, calcium 45 uptake and alkaline phosphatase activity of the irradiated tibia and the non-irradiated tibia in the same animal revealed no significant differences. The rate of calcium 45 uptake, measuring the rate of calcification, was found to be depressed following 2,000 r directly to one leg. The depression of the calcium metabolism following irradiation is similar to that found in normal aging bone. It was observed that tibia alkaline phosphatase activity concentration decreases as the animals reach maturity. Further, following 2,000 r, the phosphatase enzyme level was sharply depressed, correlating quite closely with the depression of bone growth. In normal animals, tibia alkaline phosphatase concentration was found to be linearly related to the log of the matrix weight.

The depressing action of irradiation on the growth and metabolism of bone may be due primarily to the depression of alkaline phosphatase activity resulting from destruction of the osteoblasts, which are presumably the precursors of the enzyme in bone.

The Influence of Roentgen Rays Upon the Development of the Mouse by Local Irradiation of Some Parts of the Body. V. V. Brunst and Frank H. J. Figge. J. Lab. & Clin. Med. **41:** 534–542, April 1953.

The authors describe an investigation of the effects of localized irradiation on young mice. Four hundred ninety-two mice of the C57 strain, divided into two groups, were used in the experiment. Radiation factors were 55 kv. max., 3 ma., no filter, target-object distance 12 cm. Eighty-six mice served as untreated controls.

Group I: The heads of 47 one-to-two-day-old mice were irradiated with 3,000 r (mortality: 20). As early as seven days after treatment, suppression of the development of the treated region was evident. Not only was there suppression of head development, but there was growth inhibition of the entire body. A definite effect upon brain function was manifested in disturbances of movement, though no histologic evidence of this was found. In the eyes of the irradiated heads some retinal layers (rods and cones layer) disappeared.

Group II: A narrow band midway between the fore and hind limbs was irradiated in 359 animals: 11 mice received 3,000 r (mortality: 4), 18 mice 3,400 (mortality: 0), and 330 mice 4,000 r (mortality: 182). During this irradiation of the lumbar portion of the body, the animals were shielded with a 4 mm. lead cover with a localizer slit 4 mm. in width. Paralysis was never observed following roentgen irradiation of mice at the ages of five to twenty-five days, but it was seen in some mice following irradiation at one to four days of age. This paralysis usually occurred in animals which were irradiated exactly in the region of the motor neurons controlling the hind limbs. Histologic examination showed that in most instances the appearance of the spinal cord of the paralyzed mice was normal. Obviously, the damage involved only some cells of the spinal cord and was very difficult to detect by ordinary histologic examination. In some animals, however, complete destruction of the spinal cord in the treated region was observed. It is possible that in some mice the primary damage occurred in the vertebral column and that the destruction of the spinal cord was secondary to suppression of growth and partial resorption of the vertebral column.

Eight photographs; 3 photomicrographs; 1 graph.

Effect of Whole-Body X-Irradiation on Urinary B-Vitamin Excretion of Rats. W. N. Pearson, Janet P. Owens, Granville W. Hudson, and William J. Darby. Am. J. Physiol. **173:** 120–124, April 1953.

Numerous reports suggest that nutritional disturbances may be an integral part of the acute radiation syndrome. Whether x-irradiation destroys certain vitamins (or biologically important compounds containing vitamins) *in vivo* has not been decided. The authors therefore studied the effects of irradiation upon the excretion of certain vitamins in rats.

Five mature female rats of the Sprague-Dawley strain weighing approximately 200 gm. were maintained on a complete, purified diet. Preliminary studies made on this group of animals indicated the necessity for paired feeding, and for that reason a second series of 12 rats was used. During the post-irradiation period each control rat received the amount of food consumed by its irradiated mate during the preceding twenty-four hours. The rats were irradiated in groups of 4 in a small plywood box, with a layer of rice to insure backscatter. A single exposure whole-body irradiation (500 r, including back-scatter) was administered with the following factors: 200 kv., 20 ma., 0.5 mm. Cu and 1.0 mm. Al filtration. Under the conditions of the experiment this dosage is sublethal but produces a period of sickness and a definite leukocyte depression. The preliminary studies indicated that 500 r of whole-body irradiation resulted in an immediate increased urinary volume and enhanced excretion of riboflavin, pyridoxine, niacin, and folic acid. The later experiments with pair-fed animals revealed that the anorexia caused by irradiation accounted for part of the increased riboflavin and pyridoxine excretion. Increases in niacin and folic acid excretion, however, can be considered primarily as irradiation effects.

Local Enzymatic Treatment of Radiation Necroses of the Skin. Sven Hultberg. Acta radiol. **39**: 343–352, April 1953.

The author briefly reviews the literature on the discovery, mode of action, and clinical applications of a mixture of streptokinase and streptodornase. Since good results have been reported in their use in diabetic gangrene, decubitus and other indolent ulcers, it was decided to try these enzymes in the treatment of necrotic radiation ulcers.

Varidase, a commercial preparation containing (in desiccated form) 100,000 units of streptokinase and 25,000 units of streptodornase per vial, was used in the treatment of 15 patients with radiation ulcers. A detailed description of the technic of local application of this preparation is given. Dressings with bland or antiseptic ointments were applied subsequent to enzymatic treatment. In two cases in which the necrotic ulcers were largely covered by fibrous tissue, the response to Varidase was poor. After débridement of the fibrous tissue, the enzymes promptly produced good results.

With a single exception (in which malignant disease was present), the Varidase treatment resulted in prompt relief of pain and rapid cleansing of the necrotic area. The wet sloughing tissues often dried up in one or two days. Fresh granulation tissue appeared and epithelization started. In those cases in which infection was present, supplementary antibiotic therapy was used. The author concludes that Varidase is a valuable adjunct in the treatment of necrotic radiation ulcers.

Eighteen photographs.

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